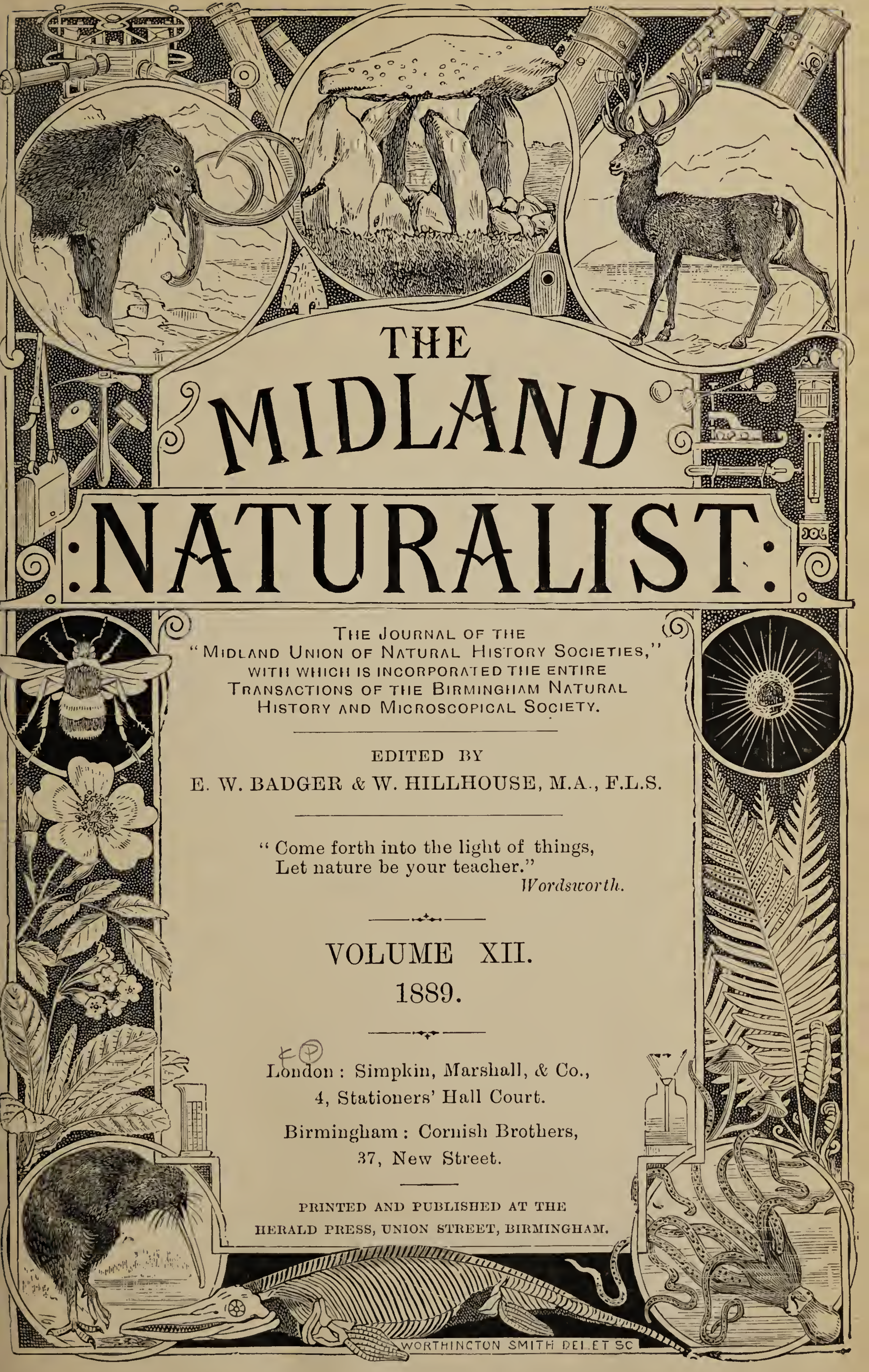

THE MIDLAND NATURALIST:

The Journal of the "Midland Union of Natural History Societies," with which is incorporated the entire Transactions of the Birmingham Natural History and Microscopical Society.

EDITED BY

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"Come forth into the light of things,
Let nature be your teacher."
Wordsworth.

VOLUME XII.

1889.

London: Simpkin, Marshall, & Co.,
4, Stationers' Hall Court.

Birmingham: Cornish Brothers,
37, New Street.

PRINTED AND PUBLISHED AT THE
HERALD PRESS, UNION STREET, BIRMINGHAM.

PRINTED BY WRIGHT, DAIN, PEYTON AND CO.,
AT
THE HERALD PRESS, UNION STREET, BIRMINGHAM.

PREFACE.

At the end of the twelfth year during which this magazine has been regularly issued, we have once more the pleasing duty of thanking our contributors for their valued help. The only cause for regret is that more of the midland Natural History Societies do not make use of our pages for the publication of more of the important papers read before them. The Members of one of these Societies—the Oxford Natural History Society—have been especially helpful to us during the past year, and have supplied us with several most interesting contributions. We trust the Members of other Societies will follow their example, and so add to the interest of our next volume, for which we are glad to announce that we have already received several papers of general interest.

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Map of Norway Tour.

W. P. Marshall del. Herald Press Lith.

THE MIDLAND NATURALIST.

"Come forth into the light of things,
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NOTES ON A TOUR IN NORWAY AND COLLECTION OF PLANTS.*

BY W. P. MARSHALL AND C. PUMPHREY.

This tour was a six weeks excursion to Norway in the present summer, from the 26th of June to the 6th of August; the route taken was direct to Bergen and the North Cape (nearly 2000 miles distance from Birmingham) followed by a three weeks land journey, as shown in the map in Plate I. The sea passage to Norway was taken from Newcastle to Bergen by the "Norge" steamer, a thirty-six hours run; starting on Tuesday evening and arriving at Bergen on Thursday morning, and then going forward the next day by the fine North Cape tourist steamer "Olaf Kyrre," with a party of about sixty fellow passengers.

On the way to the North Cape there was a stay on shore at several places. First at Throndhjem, the ancient capital of Norway, where the very interesting old cathedral was visited, which is in process of restoration.

Then Torghatten was visited, an island rock that has a remarkable natural archway through the entire rock, which was reached by a half-hour's scramble up the side, and gave a striking view through the large archway of the sea and numerous islands beyond.

The Lofotens were next visited, islands out in the open sea, a couple of hours steaming from the main land, with magnificent jagged mountains forming a continued panorama of striking and beautiful outlines, with a range extending over 100 miles. We passed round one of the islands, returning by a narrow channel between two of them, the Raftsund, which is specially fine in scenery. The passage onwards to the North Cape, like much of the previous voyage, was almost

*Read before the Birmingham Natural History and Microscopical Society, October 9th, 1888.

continuously between rocky islands and the main land, presenting a constant variety of fine scenery.

Tromsoe was stopped at for a day, and the party took a two miles excursion from there up Tromsoedal to visit a Lapp encampment, where a herd of 200 reindeer was seen, the visitors going about amongst the reindeer and the Lapps.

The Midnight Sun was seen the first time on 4th July, the night before getting to Tromsoe; the steamer anchoring in a position clear of the islands before midnight, for the purpose of giving the party the anxiously expected sight.

Hammerfest was visited on Friday morning, 6th July, and the same night we were on the top of the North Cape viewing the Midnight Sun again, a week from the time of leaving Bergen. The ascent is an hour's walk from the ship; first a steep zig-zag climb of 800 feet, and then a mile walk to the summit, 950 feet high. The North Cape is on an island named Mageroe, which we sailed round.

The Svaerholt Bird-rock, near the North Cape, was visited previously; it is a great rock rising abruptly out of the sea, 1200 feet high, covered with enormous numbers of birds which suddenly, on the firing of a cannon, fill the air overhead with a white cloud like a heavy snowstorm.

Lyngen Fjord was visited on the return, the steamer going up the fjord and back again, a two hours trip, for the sight of the fine jagged mountainous rocks, with picturesque glaciers.

The great Svartisen glacier, which is just at the Arctic Circle, was visited; the party landed in boats, and scrambling over the half-mile of old moraine that lies between the foot of the glacier and the sea, were then able to get a little way on to the glacier.

We left the North Cape steamer at Molde, a day's sail short of Bergen, and then started on a three weeks inland trip to the celebrated Romsdal, with its great Romsdalshorn and Troll-tindern towering up to more than 5000 feet height, one on each side of the valley; the Geiranger Fjord and Brixdal glacier; up Sogne Fjord to Laerdalsoren and Borgund, up Jostedal to Nigaards Brae glacier, through Naero Fjord and Naerodal to Vik and Voering Fos, and then on to Odde, Buer Brae glacier, and Gorsvingane Pass, 3400 feet height above the sea. Then by the Hardanger Fjord to Bergen, and back to Newcastle.

A special charm in this trip was the sight of the waterfalls. Norway is truly called the country of fjords and waterfalls (Fos); the fjords with their grand and continually varied scenery, and the innumerable waterfalls of most charming variety, including a large number of great size.

During this inland trip, and at the various stopping places of the North Cape steamer, we had opportunities for collecting plants: we were much struck with the active condition of the vegetation, especially in the leaves of the trees; and the country was quite a wild garden of flowers, many British plants being met with in unusual luxuriance of growth. This is due partly to the mild climate caused by the Gulf Stream, which impinges on the whole coast up to the North Cape. The temperature on the North Cape at midnight was as high as 55°, although it is within 19°, or only 1300 miles, distance from the North Pole; and at Hammerfest, which is the most northern town in the world, the temperature was actually 70° in the shade at midday.

The effect of the Gulf Stream is shown upon the circumpolar map in Plate I., in which is given the temperature curve of 32°; or the curve passing through all the localities in which the mean annual temperature is the freezing point, the winter averaging as much below the freezing point as the summer averages above it. This curve reaches nearly as low a latitude as 50° in the two great continents of Asia and America, being there at about the latitude of the South of England; but the gigantic warming effect of the Gulf Stream indents the curve past England and the coast of Norway, to a point actually 600 miles north of the Arctic Circle, although the curve is 1000 miles south of the Arctic Circle in the continents of Asia and America. This causes the remarkable and exceptional mildness of climate of the whole coast of Norway up to the North Cape, as well as of the west coast of the British Isles.

The great exciting cause however of the active condition of the vegetation, is the continuous sunlight that is day and night acting upon the plants: their development is never checked by the darkness of night, and there is the continuous stimulus of sunlight all through the summer. At the North Cape itself, the sun never sets for 2½ months, from 11th May to 30th July, and in the other less northerly positions within the Arctic Circle the sun is so little below the horizon for any portion of that time, that there is practically continuous daylight throughout the 2½ months.

In our trip we had the sun continuously above the horizon for six days and five nights, and were so fortunate as to see the Midnight Sun on four successive nights. At the North Cape at midnight the sun was about eight diameters above the horizon, when we were there on July 6th, and it was shining brilliantly, with a light about equal to the light that we have usually on autumn afternoons in this country. Measured actinically, the light at midnight was found to be equal to

one-fifth of the photographic power ot the average midday sun in England.

Of the Plants collected, one of the most interesting is *Cotula coronopifolia*, a composite plant that is very limited in Europe, and is found in only one locality in Norway, on marshy ground at the head of a sea fjord, 90 miles distant from the open sea. Its home is considered to be the Cape of Good Hope.

Another local plant, *Aconitum septentrionale*, a large Monkshood belonging specially to Norway and Sweden, was found plentifully distributed over the country, and in Romsdal were found very fine specimens, one measuring 6ft. in height, with leaves 21ins. across, and flowers 1½ins. long.

On the North Cape itself, several Swiss plants were met with, and specimens of many British plants, including:—*Saxifraga oppositifolia*, *Loiseleuria procumbens*, *Silene acaulis*, *Dryas octopetala*, *Arabis alpina*, *Saxifraga cæspitosa*, &c. *Saxifraga cotyledon* was found very generally throughout the country, with fine bunches of flowers standing out from ledges in the rocks in many districts.

The beautiful heaths, *Andromeda polifolia* and *Menziesia cœrulea*, were found in many places, and the delicate fern, *Woodsia ilvensis*, was particularly luxuriant in growth. *Eriophorum latifolium*, the large Cottongrass, was very abundant, and attained a remarkably large size in its cotton tufts; the smaller Cottongrass, *Eriophorum alpinum*, was also found at Nigaards Brae in Jostedal.

Mulgedium alpinum, the blue Sow-thistle, was found at one place near Voering Fos. and *Arnica montana* was seen in rich orange masses in the meadows in one district. *Viola tricolor* and *Alchemilla* were specially abundant, also *Saxifraga Aizoides*.

A novel position for plants was on the roofs of the houses; the roofs generally throughout the country, including the majority of the houses in the smaller towns, are covered with turf, on which is an abundant crop of vegetation; grass, plants, and shrubs, and even small birch trees eight or ten feet in height are frequently seen in the country growing upon the roofs. At Hammerfest we actually saw a couple of kids grazing on the roof of a house. The houses are really roofed with birch bark, which is laid on in many layers, like thatching with straw, up to a total thickness of about four inches, and is then completely waterproof; and, to prevent the bark getting blown away, it is covered with a thick layer of turf, which grows together and forms a complete protection, the roof appearing to last, without requiring repair, until the house goes

to decay. The houses are constructed entirely of wood, excepting the chimneys, which are stone.

The plant *Cotula coronopifolia*, that was first referred to, is a rare object about which there is a history of much interest in connection with the migration of plants. We found it at the only site where it is known to exist in Norway, Laerdalsoren (see map, Plate I.); and this was shown to us by Professor Lindman of Upsala University, Sweden, who has since kindly sent us further information on the subject, and a reference to the "Botanische Zeitung" for January 17th and 24th, 1862, which contains a careful detailed account and history of the plant by Dr. Buchenau.

This plant was first found in Europe, a century and a half ago, in 1739, by Moehring of Jever in North Germany (see map), near the coast, between Denmark and Holland, and he at first supposed it to be *Matricaria maritima*.

The plant was next recorded in 1767, as found at Neuenburg in the same district, on the high road, where rainwater accumulated and the spray from the sea reached; and also on the coast of Jahde Bay, near Jever, where Moehring had lived. Then in 1788, Ehrhard of Neuenburg, and subsequently other botanists found the plant in that district, and also along the Weser River, in several places all exposed to the spray from the tide.

In the next century, in 1852, Schloeter found the plant again in the same locality, and it also grows now in Nordeney Island, off the coast between Jever and Emden; but in 100 years it has only been found to have spread itself to a few other places in the province.

It has occurred also in Sweden on a small spot in Bohuslan, near Goteburg (see map), but there are now no more traces of the plant to be seen in that place. It is recorded in Spain in 1852, by Willkomm, and in Portugal, in 1855, by De Candolle, and is also named as having been found in Candia.

The original home of *Cotula coronopifolia* is considered to be the Cape of Good Hope, but it has also been found in Egypt, in Australia, Tasmania, and New Zealand; and in South America, in Brazil, Monte Video and Chili; in all the cases it was found growing in low lands near the seashore, as in Germany. The plant requires a site with short grass, and a soil with a certain richness of soluble salt, although it cannot be called a salt water plant. The Norway locality in which we found it, Laerdalsoren, is a low marshy ground at the head of one of the long sea fjords.

As regards the migration of this plant, it may be noticed that all the localities where it has been found in Germany, Sweden, and Norway, are on the West coast, exposed to the influence of the Gulf Stream; and the flower is a composite with winged seeds, which admit of being carried long distances by an ocean current.

(To be continued.)

THE FOUNDATIONS OF OUR BELIEF IN THE INDESTRUCTIBILITY OF MATTER AND THE CONSERVATION OF ENERGY.*

A CRITICISM OF SPENCER'S "FIRST PRINCIPLES,"

PART II., CHAPTERS IV., V., AND VI.

BY J. H. POYNTING, D.SC., F.R.S.

I confess that when I accepted the invitation to give a paper on the chapters in Spencer's "First Principles" dealing with the Constancy of Matter, Motion, and Force, I had no idea of the difficulty of the task which I was undertaking. I remembered that when, many years ago, I read the chapters I disagreed with their general drift, and I thought it would be tolerably easy to disagree still. And so I have found it. But it is one thing to disagree with an author, and quite another thing to give clear reasons for your disagreement, especially when the subject is so difficult and your author is so great a master of argument as Spencer. And there is to me another difficulty in that I have never studied Spencer's system as a whole. The chapters I am to deal with form but a part of that whole; one staircase, as it were, in a grand edifice, which you have watched building stone by stone. I am venturing to criticise this particular staircase when I have not studied the plans of the building, and know not whence it springs or whither it leads. I am a mere carpenter venturing to criticise the work of a great architect. I don't know that I am even a carpenter. I have been, for many years, especially engaged in teaching people how to climb this particular kind of staircase, and perhaps you may think that that is hardly a

* Read before the Sociological Section of the Birmingham Natural History and Microscopical Society, November 22, 1888.

sufficient warrant for a criticism of the nature of its materials and the strength of its supports. But this is the task I have undertaken.

If I may assume that you are acquainted with Spencer's argument, I need only briefly sum it up as follows :—

In Chapter IV. he maintains that the indestructibility of matter is a necessary truth, one of which we cannot imagine the contrary when we once clearly present to our minds the meaning of the terms "matter" and "indestructible." He argues that the so-called chemical and physical proofs based upon weighings really assume the principle in assuming that the weights used to counterpoise are constant in their value. He concludes that, when analysed, the indestructibility of matter is found to mean the persistence of force. For if we use the chemical proof, the constancy of weight means persistence of gravitative force, and, if we regard the principle as a necessary truth, we again come to persistence of force, for it is by force that we really know matter.

In Chapter V. it is argued that the continuity of motion is a truth of the same order, one of which we cannot imagine the contrary. When we contemplate a swinging pendulum, and note the recurring appearance and disappearance of its motion, we cannot suppose that that of which the motion is a sign has been annihilated when the motion ceases at the end of a swing. We must suppose that there is a *continuous existence* now shown by the motion, and now by the pull down which we feel if we hold the pendulum in its highest position. This existence we think of as the objective correlative of muscular effort ; we think of it in terms of force. Again, if a moving body is gradually brought to rest, it is stopped by force exerted by some other body or bodies upon it, and this retarding force has a reaction on the acting bodies, handing on to them the motion lost by the body as it slackens speed. Again we think of the motion being communicated by force. If we seek to prove the continuity of motion, our so called proofs really assume the persistence of force in some form or another, either in the constancy of the masses concerned, or in the constancy of the measuring instruments used. Hence we again come to the same foundation as that on which the indestructibility of matter is built, viz :—the persistence of force.

Having concluded that the indestructibility of matter and the continuity of motion ultimately imply the persistence of force, Spencer proceeds, in Chapter VI., to examine the warrant we have for the truth of this last doctrine. He asserts that all our measures assume it, and that therefore we

cannot by experiment prove it. We cannot show that it rests on any other truth. All reasoned out conclusions must rest on some postulate. We go on merging derivative truths on wider and wider truths, until at last we reach a widest truth which can be merged in no other or derived from no other. And whoever contemplates the relation in which it stands to the truths of science in general will (he says) see that this truth transcending demonstration is the persistence of force.

It is remarkable that so calmly and closely reasoned an argument should have excited so much heat as this has done in certain physicists: all the more remarkable in that physicists have not, for the most part, closely examined the foundations of their great generalisation for themselves, have not clearly realised what is the result of experience and what is metaphysical assumption. Perhaps it is from this very neglect of the subject that some of their bitterness towards Spencer has arisen. It is not pleasant to have a stranger coming in to set one's house in order. But there is, I think, another reason. The physicists have by toilsome steps been pushing into a hitherto unknown country; they have been drawing careful maps describing the details of its features as they came to them, and now after putting together the results obtained by generations of explorers, they have found the course, as it were, of the great mountain ranges and rivers. But Mr. Spencer seems to say that after all they need not have toiled so much. From the border of the country the general lie of the strata might have been made out, and it might have been seen that the mountains and rivers could not run otherwise than they do. And indeed all their survey depended on a base line at the border; all the boasted measures were but in terms of that base line, so that all their maps were but repetitions of it. It is always irritating to be told that if you had only kept your eyes open you might have saved your pains. An implication of unwisdom is always the direst insult.

But after all, Mr. Spencer may not be right. For my own part, I share the view of the physicists, that his arguments are to a great extent unsound. I hold that the field of science cannot be mapped with certainty from its borders, and that our knowledge of its main features is due solely to the explorers. Further, in that these explorers are fallible, I hold it possible that their maps may be wrong, at least to some extent, and that future generations may show that we have been too hasty in assuming that we knew even the position of the main features.

Were I to criticise Mr. Spencer's statements point by point, there would be danger that we should be confused by differences about mere details. I propose therefore to state my own beliefs in these matters, and to give as far as I can what I consider the warrant for them.

The main work of the physicist is the investigation of the resemblances or similarities which he observes in phenomena. The description of these resemblances he embodies in physical laws. For instance, he observes that bodies resemble each other in falling to the ground when no other body intervenes; that they resemble each other in remaining at rest unless there is some other body to whose presence their motion can be ascribed; that they resemble each other in that they require an effort from him to set them moving, an effort which he feels through his muscular sense ; and so on. These are mere qualitative resemblances which can be discovered by simple observation, and every intelligent being has through his own observation, through his early instruction and possibly through the observation of his ancestors, become aware of a number of such resemblances or physical laws which he regards as mere common sense. In fact, in this respect, we are all like Moliere's M. Jourdain—we have been speaking physics these forty years and never knew it. But the physicist, of course, goes far beyond this classification of simple observations. He makes experiments as well as observations. He calls in the aid of instruments and makes measurements; he discovers that phenomena resemble each other in various ways which can be expressed by numerical relations. Let us take an example.

An experimenter puts a piece of rock salt and a vessel of water side by side on the one pan of a balance, and counterpoises them by weights on the other pan. He now powders the salt and finds the weight is still the same; putting the salt into the water and stirring till it is all dissolved, the balance is unchanged. Finally, distilling the liquid and collecting the water and the salt which remain behind, he has them separate, and placing them on the balance, they are counterpoised by the same weight as before. This experiment may serve as a type of all the various weighing experiments, chemical and physical, which are taken as proving the indestructibility of matter.

What conclusions does our experimenter draw ? Firstly that the salt was in existence throughout the experiment, and secondly that its weight remained the same. But in drawing this conclusion he makes assumptions. He believes that the salt appearing after distillation is the identical salt

which disappeared in the water. He could follow it for a time. He saw it change its condition from a lump to a powder. But when it went into the water it ceased to affect his sense of sight. Yet the fact that salt could be obtained from the water again leads him to think that it was in existence all the time. And he ascribes to the salt in its invisible state the change in weight of the water and the change in its taste. His belief in the continuity of existence of the salt, in its identity, rests on a postulate which for shortness we may term the continuity or identity postulate. Let us, for the sake of clearness, consider another example of the use of the same postulate.

Suppose that I am with a man whom I know, in a room with a door leading into another empty room, and suppose that shortly before my friend has gone into the other room out of my sight, and has now returned again. I do not suppose that he went out of existence in his absence; I believe that he was in the other room, preserving meanwhile his identity. I may have spoken to him while he was out of sight, and may have received an answer, and this affection of another sense than sight I ascribe to him. I base my belief in his continuity on the same postulate as that on which the experimenter bases his belief in the continuity of the salt. I have not a sufficient knowledge of philosophy to put the postulate in its proper form, but a consideration of cases in which it would not or might not apply may at least give us a working form of statement. If, during the weighing experiment, somebody had been observed introducing fresh salt on to the balance, we could no longer assert identity of the initial and final salt. Or if, in the second example, my friend had a twin brother in the neighbourhood, and if the adjoining room communicated with the street, I might not be sure of the identity of the friend underlying the two appearances. Perhaps, then, we may guard against such cases by the statement that "if a thing affects us in the same way as a thing has previously affected us, and if we have reason to suppose that no fresh thing has come in from the outside, then the two affections arise from the same thing."

Secondly, with our experimenter, we assume that the weights used in the counterpoise preserve a constant weight. Mr. Spencer seems to think that this assumption is ultimate or fundamental. But let us examine the assumption a little more closely. To begin with, we assume continuity of existence of weight. We have only direct sense-warrant for the existence of the down-pull while putting the weights on the pan with our hands and while

taking them off again. But we apply the continuity postulate and assert that the weight existed while the masses were on the pan. But we go further : we assert constancy in quantity, which is something more than mere continuity of existence, and we have various methods of testing our assertion. We may allow the weights to fall, and time their fall through a given distance in successive trials. All experience tends to show that the time of fall is constant, and we conclude that the weight is constant. It may be argued that we use a clock for the time, and that the clock pendulum may possibly vary in weight, simultaneously and in like proportion with the balance weights. Very well, then ; let us use a watch, and we get still the same time of fall in our successive trials. Or let us use a different test, and put the weights on a Salter's Spring balance, and they always stretch the spring equally. If it be argued that possibly the elasticity of the watch spring and of the balance spring varies in like proportion with the weight of the weights, then, I say, let us go to the ultimate court of appeal—my own sensations. If I have practised much with my pressure sense and my muscular sense, I may weigh the weights with my hand and be certain of their approximate constancy. If it be finally argued that my sensations may likewise vary in proportion, then I say that so long as the universe is drawn to a consistent scale, and so long as I am also on that scale, any contraction or expansion of the scale, being beyond my detection, is a matter of perfect indifference to me, and I need not construct my language so as to provide for its possibility. I am content to say that the weight of the salt and the water is constant. But here I think that another postulate has crept in, which in its most general form we may state thus—"Like sensations imply like objective existences or like physical properties." We use the particular case that equal sensations imply equal objective existences or equal physical properties. For whatever test of constancy of weight we employ depends ultimately on the equality of two sensations. And indeed this postulate is the basis of all the conclusions as to the outside world which we draw from physical measurements.

Again, though we take weight as our test, the fact that the salt at the end resembles the salt with which we started in other respects than weight—in fact, that it gives us equal sensations—leads us to conclude that it is equal in quantity, *i.e.*, that none of it has been destroyed. And on such experiments so interpreted we found the principle of the Indestructibility of Matter.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from Vol. XI., page 294.)

3.—BLOCKING UP OF STREAMS.—Perhaps no one cause of floods has been more considered of late years than this, because it so readily suggests the remedy—cleaning out. The growth of weeds and accumulation of silt in the Nen, particularly since the diversion of traffic to the Northampton and Peterborough Railway, has greatly reduced the water-carrying power of its bed, and so, to some extent, been a cause of floods. The following remarks are intended to indicate, somewhat, the extent of responsibility this cause must bear.

The drainage area of the Nen above Peterborough is estimated at 620 square miles, and the ordinary summer flow of water through Peterborough Bridge at 5,000 cubic feet per minute, or 45,000,000 gallons per day. This is only about 70,000 gallons for each square mile of area drained, or ·005 inch of rain over the same area per day. The flood discharge through the same bridge has, however, amounted to 480,000 cubic feet per minute,* a quantity, it will be seen, ninety-six times the ordinary summer flow, and equal to about ·5 inch of rain over the drainage area in twenty-four hours. This is, no doubt, an exceptional amount, but in the Fen Districts of Lincolnshire and Cambridgeshire pumping power is usually provided for lifting half this amount, or ·25 inch of rain in twenty-four hours over the drainage area, into the main drains. A little consideration will show that, to prevent floods, a much greater provision would have to be made in the Nen Valley than in the Fens, for the "Upper Valley," that is the part above Peterborough particularly subject to floods, has an area of about 16,000 acres, which at times constitutes one vast reservoir, whilst the area draining into it is about 400,000 acres; so the Nen Valley has to receive the drainage of a district twenty-five times its size, whereas the Fen lands are only burdened with the drainage of a district about six times their own size.

Now, supposing the river were thoroughly dredged, and other improvements in the river bed effected, so as to reduce friction by one half, and double its capacity, these alone would not enable it to cope with the ordinary winter rains, which would deliver into the valley often from twenty to

* "Hydraulic Tables," by Nathaniel Beardmore, M.Inst.C.E.

fifty times as much water as is represented by its ordinary summer discharge, much less with some of the larger falls; for it is evident that so long as restricted channels exist, such as locks, sluices, waste-weirs, bridges, and narrow parts in the river itself, the discharging power of the river above them is only equal to their discharging power, whatever may be its capacity as a reservoir, and the locks and flood-gates at the various mills along the Nen would always be used in such a manner as to keep the river as nearly bank-full as now, until just before a flood was expected. For these reasons I have attached less value to the blocking-up of the Nen as a cause, and its cleaning out as a remedy for floods than many people, though it is a factor that should not be lost sight of, particularly in connection with certain other remedial causes.

Cleaning out and widening of a river anywhere does bring certain advantages, for it increases its storage capacity, and, therefore, the volume of water available for doing useful work in the dryer parts of the year, though alone it would not materially diminish floods.

The expense connected with a really efficient cleaning out of the river, and other works, would be very great at first, and for the cleaning out recurrent. The increased scour and consequent self-cleansing supposed, by some, as likely to result from a freer discharge of water, would not be perceptible eastward of Northampton because of the many impediments already referred to. The total fall of the Nen between Northampton and Peterborough is about 177 feet, but owing to the sinuous course of the stream, the average inclination is only 38·7 inches per mile; this, however, would allow of considerable scour but for the impediments. According to a survey made by Messrs. Siddons, in December, 1848, when from 10 to 30 inches of water was running over the sills of the different overshots, the total fall at the eleven staunches and thirty-three mills between Northampton and Peterborough amounted to 163½ feet, so that the actual inclination of the water between these various obstacles only amounted to 13½ feet, or an average of about three inches per mile, whilst at least 4in. per mile is needed to prevent silting up. As a matter of fact, when the overshots are not running, the motion of the water is only just perceptible, because held up in successive flats; and when they are running, owing to the perpendicular descent, the main body of water is not much accelerated. Under such a condition of things, weeds and other aquatic plants grow rapidly, and I anticipate it would be necessary to cut them twice a year to keep the stream in really good condition.

The real scour of flood water only occurs when the water is sufficiently high for the overshots, &c., to offer no serious impediment to its discharge, and then it scarcely affects the bed of the river, although it often does great damage to the banks and adjacent lands. The Nen from Northampton to Kislingbury, and from Northampton to Brampton, was cleaned out a few years since at a cost of about £1,500; also a small portion of the latter branch, near to the Castle Station, was straightened, being a necessary work in connection with the loop line of railway between Northampton and Rugby. These works have not prevented floods in the meadows west and north of the town, but none have occurred in the town itself since they were done. I doubt, however, whether any real trial of the improvements has occurred.

4.—ARTIFICIAL OBSTRUCTIONS.—Several of these have been briefly referred to already, but one or two require particular consideration.

Mills and their necessary weirs do tend to hold back water, and keep rivers nearly bank-full, with the result that floods are more easily induced. Complaints against millers and mills have been pretty continuous for a great number of years, and deservedly so perhaps, though mills need not be a cause of floods. The complaints are chiefly in respect to the excessive height of the floodgates and weirs, but sometimes on account of negligence in connection with the regulation of sluices and locks. There is always a tendency for mill-dams to get higher, for, supposing any impediment to the free flow of water to exist in the lower parts of the river, this will increase the height of the tail water at the mill next above. The result of this is that the miller here finds it necessary, in order to get the same power, to raise his head of water, but if he does not at the same time raise his wheel, he must raise the head more than the tail is raised, in order to overcome the resistance of the dead water; and so the banks are heightened, and possibly flash boards put up at the weirs, and it has happened that ancient weirs and back-brooks have been stopped. When this kind of thing is done at one mill, it must be repeated at the mill next above, and so the evil increases. A survey, made by Mr. Aris in 1826, showed that, owing to these operations, the water was raised between Thrapstone and Nun Mills, Northampton, twenty-three feet altogether above the legal height as ordered by the Commissioners of Sewers (9th Charles I., 1633).*

* See "Drainage of the Nene Valley," by the Rev. Charles Henry Hartshorne, 1848.

It has been suggested that if the whole of the water-mills on the Nen were pulled down, the sacrifice would be slight compared with the injury they inflict on the lands of the Nen Valley. This seems to assume that floods need not occur if mills were absent, an assumption not very justifiable, particularly if the river were maintained in a navigable condition. It seems to me that it would be a very retrograde step to do away with the mills, and cease to use the power of the river, particularly as the evils usually attributed to them can be remedied without such a drastic method.

Mills in some respects are an absolute advantage, for they help to keep back and conserve the water of rivers for the dry season of summer, which otherwise would be lost.

Bridges are answerable for part of the evil arising from floods. Some of the ancient bridges are inadequate to discharge the water wishing to pass through them, and the water may be at times a foot higher on one side than the other. This may be the result of faulty construction, or the blocking up of side arches through neglect. One of the most prominent instances of faulty construction was the old bridge at Wisbeach. This had a sectional area less than half that of Peterborough bridge, being only 796 square feet as compared with 1,856 square feet. The present bridge at Wisbeach has an area of 2,500 square feet.

A number of minor causes tend either to increase the amount of water reaching the valleys, or to bring it down more rapidly; such as *improved systems of village drainage*, and *diminution of woodlands;* also some of the improvements made by riparian proprietors to protect their own lands add to the flooding of others, both *by bringing the water more rapidly to the area below not improved*, and *by diminishing the flood capacity of the valley*.

The embanking of a river may even add to floods, for embanking the sides will usually lead to a raising of the bed, and so the water in all the streams feeding it will be kept higher, and the more easily be made to overflow. The same embanking, too, tends to prevent the discharge of floods into the river.

REMEDIES FOR FLOODS.—Several of the proposed remedies for floods have already been considered, because intimately associated with the causes, but one or two others remain to be considered.

Washes of the Nen.—Perhaps the most effective way of dealing with flood water, if the object is simply to diminish injury in a particular district, is that adopted in connection

with the Nen below Peterborough. For twelve miles below Peterborough a large basin or reservoir has been constructed, by making banks on each side of the river at an average distance of half a mile apart. This "*wash*," as it is called, has a superficial area of about 3,750 acres, or 1 per cent. of the area draining into it, and is sufficient to hold 1 inch depth of rainfall over the drainage area above it. An extraordinary flood fills this to a depth of 7 feet or more, but the water has never run over. The wash affords good pasturage in summer time. Like several of the other remedies referred to, this is only a partial one, however, for the heaping up of water in this wash both increases the velocity of discharge between it and the sea, and increases the height of the flood in higher parts of the valley. If this system of making flood-banks were carried out along the whole valley subject to floods, with a gradually decreasing sectional area, and the tributary streams were similarly treated to above the flood line, floods would be almost unknown outside this area, and only the superficial accumulation of water in a soil at present admitting of no effectual drainage would remain to be dealt with.

With regard to the other remedies, it is easy to see that if the *flood-gates* and *overshots* were made progressively larger towards the outfall, the latter being constructed so as to have a sectional area of discharge below the flood line equal to that of the total sectional area of the river above them, and also to give a less vertical fall to the water running over them, by continuing the inclined surface to about the low-water level of the river; if the river were progressively cleaned out in an opposite direction, and the locks and other artificial obstructions intelligently regulated, the narrow parts made wider, and the winding parts straightened, a very great improvement would be brought about; to the extent of preventing many floods, and facilitating the discharge of all. Such improvements carried out in the upper part of the stream only would, of course, add to the injury lower down, by bringing the water to these latter more quickly. The legal and pecuniary difficulties connected with the carrying out of these details would be very great, and the former, perhaps, under the present condition of legislation, insuperable.

It will have been noticed that the general tendency of nearly all the plans so far considered is to get rid of the water more rapidly than the present condition of things permits, so that a great scarcity of water would prevail during an ordinary summer. They all have the drawback that the water got rid of would do no useful work.

(To be continued.)

"THE NATURALIST IN NICARAGUA."*

Every naturalist, and especially every naturalist who is an evolutionist, will give a cordial welcome to this exceptionally interesting volume, which is "a narrative of a residence at the gold mines of Chontales; journeys in the Savannahs and forests; with observations on animals and plants in reference to the theory of evolution of living forms." Originally published by Mr. Murray in the year 1873, the popularity of the book soon exhausted the edition, and for many years it has become rare, and even disappeared from second-hand catalogues. If testimony other than that contained therein were wanting to its merits, the following eulogium, written by the illustrious Darwin in 1874, to his friend, Sir Joseph Hooker, is sufficient:—"Belt I have read, and I am delighted that you like it so much; it appears to me the best of all natural history journals which have ever been published." Mr. Belt dwelt in Nicaragua for four and a half years—from February, 1868, to September, 1872—and this is a record of what he saw, and of the theories which subsequently arose thereon:—"Some thought out on the plains of Southern Australia; some during many a solitary sleigh drive over frozen lakes in North America; some on the wide ocean; and some, again, in the bowels of the earth when seeking for her hidden riches. The thoughts are those of a lifetime, compressed into a little book."

The occupation of the author, who had been previously well schooled as a member of the Tyneside Naturalists' Field Club, and who had written many scientific papers in divers journals besides, was to superintend the mining operations of the Chontales gold-mining company. His scientific observations recorded in this volume were therefore—all honour to him—made in his hard-earned leisure. It is not stated whether he gained his fortune in his venture. Probably he did not. But he had another kind of wealth, surpassing the value of "gold and precious stones," which kings themselves cannot command. He had the seeing eye and the hearing ear to read the great Book of Nature, and the power to interpret the truths which Nature only reveals to her diligent and trustful students. Alas! it is truly said in the preface, that "his sun went down while it was yet day," for he died at Denver, Colorado, U.S.A., from the effects of mountain fever, at the early age of 45.

* "The Naturalist in Nicaragua," by Thomas Belt, F.G.S., second edition, revised and corrected, with map and illustrations. London: Edward Bumpus. 1888. Crown 8vo, pp. i-lxix., 1-403.

It is impossible within the brief limits of these pages to do justice to this beautiful volume, which abounds in observations and generalisations most valuable on inorganic (1), organic (2), and super-organic (3) phenomena. We can only touch on a few of the most interesting matters recorded in the order above indicated.

With regard to inorganic phenomena (1), we are, on the first page of the book, made acquainted with a typical instance of the rapidity which characterises some geological changes. The River San Juan receives the greater part of the drainage of Nicaragua and Costa Rica, and it is the outlet of the great lake Nicaragua into the Atlantic ocean. "Twenty years ago the main body of water ran past Greytown (San Juan del Norte); there was then a magnificent port, and large ships sailed up to the town, but for several years past the Colorado branch has been taking away more and more of its waters, and the port of Greytown has in consequence silted up. All ships now have to lie outside, and a shallow and, in heavy weather, a dangerous bar has to be crossed." Evidences of glacial action were traceable at San Rafael—boulder clay extended for miles, "and the angular and sub-angular stones that it contained were an irregular mixture of different varieties of trap, conglomerate, and schistose rocks;" but the author was "unprepared to believe that the glacial period could have left such a memorial of its existence within the tropics at no greater elevation above the sea than 3,000 feet." And again: "The evidences of glacial action between Depilto and Ocotal were, with one exception (that of striation, not always preserved), as clear as in any Welsh or Highland valley. There were the same rounded and smoothed rock surfaces, the same moraine-like accumulations of unstratified sand and gravel, the same transported boulders that could be traced to their parent rocks several miles distant." The author evidently believed in the existence of the fabled continent of Atlantis. Approaching the subject from the side of Natural History, he was driven to look for a refuge for the animals and plants of tropical America during the glacial period, when he found proofs that the land they now occupy was at that time either covered with ice, or too cold for genera that can now only live where frost is unknown. He had arrived at the conclusion that they must have inhabited lowlands now submerged, and, pursuing the subject still further, "he saw that all over the world curious questions concerning the distribution of races of mankind, of animals, and of plants, were rendered more easy of solution, on the theory that land was more continuous once than now;

that is, lands now separated were then joined together, and to adjacent continents; and that what are now banks and shoals beneath the sea, were then peopled lowlands." Volcanic energy and its effects are ably discussed in regard to Masaya, which, at the time of the Spanish conquest in 1522, was in full activity. "The credulous Spaniards believed the fiery molten mass at the bottom of the crater to be liquid gold, and through great danger, amongst the smoke and fumes, were lowered down it until, with an iron chain and bucket, they could reach the fiery mass, when the bucket was melted from the chain, and the intrepid explorers were drawn up half dead from amongst the fumes." The late Charles Kingsley's graphic description of the great eruption of St. Vincent, in 1812, is quoted from "At last;" and there is a very closely-reasoned passage showing that Mr. Belt had convinced himself that Lake Masaya and similar basins in the same area "have been blasted out," *i.e.*, formed by volcanic energy.

To the biologist, of course by far the most interesting portions of the book are those which deal with organic phenomena (2). The bright fiery-red colouring, on a black velvety ground, of the polygamous male tanager *(Ramphocœlus passerinii)*, make it conspicuous to birds of prey, while the greenish-brown sober suit of the female is protective. Accordingly, "when a clear space in the brushwood is to be crossed, such as a road, two or three of the females will fly across first, before the male will venture to do so, and he is always more careful to get himself concealed amongst the foliage than his mates." Illustrations of mimicry abound. A curious longicorn beetle *(Desmiphora fasciculata)*, covered with long brown and black hairs, closely resembles the short, thick, hairy caterpillars that are common on the bushes. Insectivorous birds will not touch the latter, hence the beetle from its resemblance derives protection. Wasps and stinging ants have hosts of imitators amongst moths, beetles, and bugs. The author points out to those unacquainted with Mr. Bates's admirable remarks on mimetic forms, that "he has to speak of one species imitating another, as if it were a conscious act, only on account of the poverty of our language. No such idea is entertained, and it would have been well if some new term had been adopted to express what is meant." These deceptive resemblances are supposed by evolutionists "to have been brought about by varieties of one species resembling another having special means of protection, and preserved from their enemies in consequence of that unconscious imitation." Resemblances at first remote have in the course of ages become permanent.

The author's observations on ants are simply marvellous. Three forms were specially studied: the foraging ants (*Eciton hamata* and *E. predator*), the leaf-cutting ants (*Œcodoma* ——?), and a curious parasitic form peculiar to the "bull's horn thorn" (*Pseudomyrma bicolor*). Darwin has already shown, in the "Descent of Man," that the cerebral ganglia in ants are more developed than in any other insect. and in the Hymenoptera, of which they stand foremost, they are many times larger than in the less intelligent orders, such as beetles. Belt draws an interesting parallel between the Hymenoptera and the Mammalia, and points out that they both make their first appearance early in the Secondary geological period, but that it is not until the commencement of the Tertiary period that ants and monkeys appear. The parallel ends here, as no species of ant has attained great superiority over its fellows, while Man has advanced far above all other Primates. With this explanation, light is thrown on the proceedings of the ants. Respecting the foraging ants, it is mentioned as a curious analogy that, like the primitive races of mankind, they have to change their hunting grounds when one is exhausted and move on to another. In the capture of their prey they exhibited a well-planned system. Moving in dense masses three or four yards wide, and so numerous as to blacken the ground, "smaller columns would first flush the game—cockroaches, spiders, and other insects"—which, in the confusion, would sometimes bound into the middle of the mass, soon to be overpowered, bitten to pieces, limb from limb, and ultimately carried to the rear. Curious instances are recorded of the efforts of some of the victims to escape. In these the spiders exhibited the greatest intelligence, sometimes putting a good distance between them and their foes, at other times hanging suspended from a branch by a silken thread. Leaf insects feigned death sometimes. Ultimately the whole ground invaded, up even to the extremities of the twigs of the trees, would be cleared of every living insect, not too large to escape. The ant army is usually followed by a number of birds—ant-thrushes, trogons, creepers, and others—waiting on the trees, or pursuing and catching the insects that fly up. Among the ants, in addition to the dark-coloured workers and light-coloured officers, there are larger individuals "with enormous jaws." These are usually concealed. directing the others, and only appearing when danger arises. As to the leaf-cutting ants, their ceaseless pertinacity in the spoliation of the trees—more particularly of introduced species—their devastation of young plantations of orange, lemon, and mango trees, all this and more is told. The columns of these

ants are sometimes several hundred yards in length, reaching from the formicarium, or ant city, to the feeding ground. On closer examination a double stream of these minute pests, one laden with leaves, looking like a mimic "forest of Birnam," the other empty-handed and returning each for a leaf. The leaves are cut off with the sharp scissor-like jaws of the ant, clinging hold by one leg so that the leaf does not fall off. Mr. Belt actually satisfied himself that these leaves were carried to the formicarium, *not* to be eaten or used in forming the nest, but for the purpose of growing a minute fungus, upon which the ants feed—in fact, they are regular mushroom growers! The following, among many others, is adduced as an instance of the reasoning powers of these wonderful little animals:—"A nest was made near one of our tramways, and to get to the trees the ants had to cross the rails, over which the waggons were continually passing and re-passing. Every time they came along a number of ants were crushed to death. They persevered in crossing for several days, but at last set to work and tunnelled underneath each rail. One day when the waggons were not running, I stopped up the tunnels with stones; but although great numbers carrying leaves were thus cut off from the nest, they would not cross the rails, but set to work making fresh tunnels underneath them. Apparently an order had gone forth, or a general understanding been come to, that the rails were not to be crossed." The third form of ant studied by the author was that tenanting the interior of the "bull's horn thorn," a curious plant of the Acacia tribe, belonging to the *Gummiferæ*, with bi-pinnate leaves, growing to a height of 20 feet. It is a most remarkable case of commensalism. No harm is apparently done by the ants to the plant, for, notwithstanding that they feed on its honey-like juice, they in return protect it from the ravages of other insects (as these ants sting powerfully), especially those of their leaf-bearing congeners. The tricks recorded by the author of a tame white-faced cebus monkey were most curious and strangely human. It would tempt ducklings within reach by a piece of bread, and then kill them by a bite on the breast; it would pick pockets, pull out letters and take them out of the envelopes. "Once he abstracted a small bottle of turpentine from the pocket of our medical officer. He drew the cork, held it first to one nostril then to the other, made a wry face, re-corked it, and returned it to the doctor!" The humming birds noticed were both numerous and beautiful, and there is an instance recorded of their fertilising a rare pitcher plant (*Marcgravia nepenthoides*).

"The flowers of this lofty climber are disposed in a circle, hanging downwards like an inverted candelabrum . . . and the birds, to get at the pitchers (containing a sweetish liquid), must brush against them, and thus convey the pollen from one plant to another." The hairless dogs mentioned by Humboldt were seen by Mr. Belt, and it is pointed out by him that they would have an advantage in the "struggle for existence" over hairy ones, which are largely infested with Ectozoa in tropical climes. Among nocturnal animals "the skunks move slowly about, and their large white tails render them very conspicuous. Their formidable means of defence makes for them the obscure coloration of other dusk-roaming mammals unnecessary, as they do not need concealment."

Very little space remains to touch on super-organic phenomena (3). The country of Nicaragua, discovered by Gonzales, was subdued in 1522 by Hernando de Cordova; and in his book Mr. Belt over and over again speaks of the degenerate condition of the natives since the Spanish conquest, especially the half-breeds. He found everywhere proofs of the iniquity of the Spaniards and of the superiority of the old Indians—their ancient sculptures—their good government—their love of flowers. "No eye-servers were these Indians; before and behind they bestowed equal pains and labour on their work." As a redeeming feature, he speaks of the free hospitality of the present inhabitants. "It is the universal custom of the Mestizo peasantry to entertain travellers, to give them the best they have, and to charge for the bare value of the provisions and nothing for the lodging." Their absence of patriotism, and their indolence, is much to be deprecated. The only work is done by the females; the men keep up their dignity by lounging about all day, or lolling in a hammock, all wearied with their slothfulness, and looking discontented and unhappy. Law-suits are frequent, and the corruption of the judges, who are badly paid, is notorious. The absence of newspapers renders trustworthy intelligence impossible. Petty thefts are common enough, but robberies with violence are rarely committed. The remedy for all this is "the gradual moving down southward of the people of the United States. When the destiny of Mexico is fulfilled, with one stride the Anglo-American will bound to the Isthmus of Panama, and Central America will be filled with cattle estates, and with coffee, sugar, indigo, cotton, and cacao plantations. Railways will then keep up a healthful and continuous intercourse with the enterprising North, and the sluggard and the sensual will not be able to stand before the competition of the vigorous and virtuous." Several pages

towards the end of the volume are devoted to the history of that very remarkable custom, called the "Couvade," still surviving in Nicaragua, in which the father is put to bed on the birth of a child, and receives the congratulations of his friends, while the mother goes to work as usual!

We close this deeply interesting book with reluctance. It is a worthy companion of such classical works on the doctrine of evolution as Bates's "Naturalist on the Amazons," Wallace's "Malay Archipelago," and Ernst Haeckel's "Visit to Ceylon." They make a noble quartet.

W. R. H.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, December 4th. Mr. W. B. GROVE in the chair. Mr. Benjamin Ward was duly elected a member of the Society. Mr. Herbert Stone exhibited a collection of skins from Toowoomba and Warwick, Queensland, including wallaby, koala or native bear, opossum, native cat, kangaroo, ornithorhynchus, and tail of the dingo. Mr. T. E. Bolton, a living specimen of *Clathrulina elegans*, rare. Mr. W. H. Wilkinson, stellate hairs on deutzia leaves, showing different forms of mounting, and illumination under the microscope. Mr. W. B. Grove, B.A., three specimens of *Geaster fimbriatus*, from Boldmere, near Sutton, where they were found in a garden. This is the first time that this beautiful and rare fungus has been found so near Birmingham. It has been previously found at Allesley and Alcester, and at Blockley. Also (for Miss Gingell) *Ag. carcharias*, *Paxillus revolutus*, a newly described and figured species; and (for Mr. Pumphrey) *Ag. pyrotrichus* and *Ag. cyathiformis*, from Gloucestershire.—BIOLOGICAL SECTION, December 11th. Mr. R. W. Chase in the chair. Mr. J. E. Bagnall, A.L.S., exhibited a series of plants from near Great Yarmouth, collected by Mr. R. W. Chase, including *Orchis incarnata* and *Stellaria palustris;* also, from Dursley, collected by Miss Gingell, a number of rare mosses, such as *Barbula tortuosa*, *Hypnum stellatum*, and *Gymnostomum microstomum*, giving their distribution throughout the world. Mr. E. H. Wagstaff, an example of *Polycistina*, in dry state, from Barbadoes. Mr. W. B. Grove, B.A., announced the recent discovery at Sutton of one of the earth stars, *Geaster fimbriatus*, the first time any of these interesting fungi have been recorded from North Warwickshire since the days of Withering and Bree. Mr. W. B. Grove then gave his paper on "The Salmon Fungus (*Saprolegnia*) and its Allies," giving a very full and interesting account of the mode of growth, reproduction, and effects of these parasites. They are great enemies not only to salmon, but also to fish and other animals preserved in aquaria, which are frequently infested with them when alive. It is stated that carbonate of soda prevents their growth. A discussion followed, in which Messrs. R. W. Chase, J. Levick, W. R. Hughes, and J. E. Bagnall took part.—GEOLOGICAL SECTION, December 18th. Mr. F. W. Carpenter was elected a

member of the Society; Mr. T. H. Waller, B.A., B.Sc., and Mr. John Udall, F.G.S., were unanimously elected chairman and secretary respectively of the section. Mr. Pumphrey exhibited (1) potato stones from Madagascar and from Somersetshire; (2) ironstone nodule from Kingswood Pit. This contained a number of cylindrical bodies apparently intersecting each other. Mr. Grove, on behalf of Mr. Clarke, showed two old-fashioned plates of great beauty: (1) of fungi; (2) of mosses. Mr. T. H. Waller read a very interesting and instructive paper on a "Lithia-bearing Granite," illustrated by experiment and micro-sections. Mr. C. J. Watson presented twelve micro-slides of sections of plants, &c., which he had mounted.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—November 12th. Mr. J. Madison showed specimens of *Limnæa truncatula* var. *minor*, from King's Heath. Mr. P. T. Deakin then read a paper on "The Flying Power of Birds." The writer described the bony parts necessary for flight, their position, use, and peculiarities, and the various developments and modifications in the different families of birds. The varying depth of the keel of the sternum and other modifications in the woodpeckers, diving birds, waders, and others was described. The paper was illustrated by a series of dissections of birds, comprising specimens of most of the principal families of the British species.—November 19th. Mr. Deakin exhibited specimens of *Neritina fluviatilis* var. *cerina*, from Christchurch; Mr. J. Madison, distorted specimens of *Dreisseua polymorpha;* Mr. Corbet, various specimens of hematite, from Newhaven.—November 26th. Mr. Deakin exhibited specimens of *Helix fusca*, from Clent. The evening was chiefly taken up by a discussion on the sealing, ringing, and finishing of microscopic slides, specimens being shown by Messrs. J. W. Neville, Collins, and Moore. The difficulty of securely sealing glycerine mounts was spoken of by most members, Mr. H. Hawkes recommending Damar varnish as preferable to all others.—December 3rd. Mr. J. W. Neville showed the tracheal system of *Pediculus capitis;* Mr. J. Collins, pollinia of *Orchis morio;* Mr. J. Moore, variations in the structure of hair from different breeds of dogs; Mr. Camm, *Cephalosporium acremonium*, from Hamstead, and *Craterium pedunculatum*, from Sutton Park.—December 10th. Mr. J. Collins exhibited a section of *Ripogonium parviflorum*, a New Zealand cone; Mr. J. Moore, specimens of *Vespa sylvestris*, and *Volucella plumata;* Mr. J. Madison, specimens of *Succinea putris* and *Helix rotundata*, from the Eocene beds of Headon Hill; Mr. Camm, the following fungi:—*Arcyria incarnata* and *Lamproderma irideum.* Mr. J. A. Grew then read a paper on "Insect Mimicry." The writer said the most wonderful instances of mimicry were found in exotic insects. Those resembling leaves and sticks were familiar to all. But in our own country we had many remarkable instances, though the insects were smaller and less known. The writer described mimicry as a tendency on the part of insects to imitate other objects. If we observed them closely, we should find many insects, including the guileless butterfly committing shams and frauds. In doing these, colour was a great factor. A number of instances were given where the insects and larvæ resembled the objects they rested on or associated themselves with. The writer said he should leave to a future occasion the purpose of such habits and coloration. The paper was illustrated by a collection of the insects referred to.

HERALD PRESS   LITH BIRM.

STIGMARIÆ.
FROM THE COAL MEASURES.

NOTE ON FURTHER DISCOVERIES OF *STIGMARIA* (? *FICOIDES*) AND THEIR BEARING UPON THE QUESTION OF THE FORMATION OF COAL-BEDS.

BY W. S. GRESLEY, F.G.S., M.E.

(*a*) In the first place it will be well to point out very briefly the present state, as far as I know it, of the controversy regarding this fossil plant, namely:—Was it always part of a plant—a root of a tree; or, was it only sometimes a root, and also sometimes an individual plant? That it was never a plant *sui generis* is the opinion very decidedly held by our greatest authority on the subject, namely, Professor Williamson, F.R.S. Mr. Carruthers, F.R.S., also rejects the opinion that an individual plant is sometimes represented in this fossil. From the writings of Sir W. Dawson, F.R.S., I gather that he believes only in the tree-root idea.

On the other hand, we have Prof. Leo Lesquereux, in America, whose opinion, after forty years of exploration of the coal measures for fossils, is that Stigmaria has not the structure of a root, and lived more as a creeping stem—an individual plant—than as a root of a tree. In France, M. H. Fayol and other *savants*, uphold much the same opinions as Lesquereux.

Basing my own conclusions upon certain fossils which I am about to describe, and from other considerations, I am compelled to hold much the same opinions as those held in America, France, &c.

(*b*) The true or complete character of Stigmaria then, being, in my opinion, still open to question, perhaps some additional light may be thrown upon the matter by making

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References to Plate II.

Figure 1, 1a.—Sketches of specimen of a Stigmaria in the British Museum (Natural History Department), South Kensington. No. 10,430, in Case No. 31, in Palæontological Plant Collection. About ⅓ natural size.

Figure 2.—Stigmaria from out of the "Eureka" Coal-seam, Newhall Park Colliery, Leicestershire Coal-field. ⅙ natural size.

Figure 3.—Stigmaria out of the "Little Flint" Coal-seam, Madeley, Salop. (Coalbrookdale Coal-field.) ⅓ natural size.

Figure 4.—End view of Stigmaria from out of the "Top Hard" Coal-seam. Glapwell Colliery, Derbyshire. ⅓ natural size.

Figure 5.—Side view of Stigmaria from out of the "Little Flint" Coal, Coalbrookdale Coal-field. ⅓ natural size.

Figure 6.—Stigmaria do. do. ⅓ natural size.

Figure 7.—Stigmaria (in 11 fragments) from the "Top Hard" Coal-seam, Glapwell Colliery, Derbyshire. ⅙ natural size.

known the following facts, which have recently presented themselves to the writer. Since the appearance of my communication to the Geological Society of London last June, entitled "Notes on the Formation of Coal-Seams, as suggested by evidence collected chiefly in the Leicestershire and South Derbyshire Coalfields," my particular attention has again and again been drawn to the important fact of the underclays of coal-seams whose only fossil contents are those of Stigmaria; clays, often of great thickness, with this fossil occurring at all horizons in them, but with no remains of Sigillaria Lepidodendron, &c. (the aërial portions of trees); also, the fact of like beds of Stigmaria clay being unassociated with a layer of coal or of coally material. Such fossils seem to show clearly, or at any rate are highly suggestive of these beds not representing old soils at all, and that they (the Stigmariæ in them) were seldom the roots of trees. If they were, how happens it that we very rarely indeed come across any connections between roots and stumps, as is much more frequently the case in other strata, viz., the arenaceous roofs of coal-seams, in sandstones, &c.?

My former paper also contained what practically amounted to a challenge to those who assert that coal-beds are the fossil remains of *forests*, which grew (in their earlier stages at all events) with their *tree-roots* in the underclays, to produce evidence that the Stigmariæ in the underclays were originally connected with the coal as *tree-roots*. Now, it seems to me that the fact of only two anything approaching *bonâ fide* examples of this phenomenon having been communicated to me since I wrote* as having been observed, but which, when I came to enquire closely into, turned out to be fossil tree stumps, which might or might not have had the roots attached *in situ*, as they were never actually seen but only supposed to be there, supplies me with additional good cause for so soon again bringing this subject to the fore.

(*c*) It may be well if I relate the order in which my discoveries have been made, namely, how I have been led up to writing these remarks. In my former paper I gave it as my opinion that fossils resembling Stigmaria (organisms with rootlets attached *in situ*) were occasionally found having all the appearance of being individual plants *sui generis*. High authorities, however, rejected my idea. I examined the

* My paper had a wide circulation amongst coal-mining men, being published in two mining journals at home, in two in America, and in other ways; so that there has been plenty of time for anyone to make known their discoveries if any have been made.

Stigmarian Collection in the British Museum, which, I may perhaps be allowed to remark in parenthesis, requires considerable additions to make it what it should be, as worthily representing some of the peculiar characteristics of this fossil, which, in a national collection, one expects to see. Here, in Case No. 31, in the room devoted to fossil plants, is exhibited a specimen of Stigmaria (specimen No. 10,430), and labelled as follows: "Stigmaria ficoides. Brog: Coal-measures, Coalbrookdale, Salop, a '*Terminal.*'"* This singular specimen is roughly the size and shape of a large flattish potato, measuring about 5in. × 2in. × 1½in., and is composed of clay-ironstone. (Plate II., figs. 1, 1A.) Upon its flattest upper surface, as exhibited, are fairly-well preserved and numerous regularly distributed rootlet-scars where the rootlets had their attachment. These markings are of large size, say $\frac{1}{5}$ of an inch in diameter, but they gradually die out round the sides and ends of the specimen, and do not seem to show themselves at all upon the underside. Now, as this fossil is admitted (presumably by the authorities of the Museum) to be a "terminal," and by "terminal" is understood to represent the outward end of a root or branch, but as both ends of the specimen are practically alike, I suppose it is left to the beholder to call just whichever end he pleases the "terminal." If one is a terminal the other must be, and so both ends being terminals the object must, I take it, be regarded as an *individual plant*, and not as merely a *fragment of a root.* This specimen having come from Coalbrookdale, I repaired thither in search of other like or unlike fossils. My journey was not taken in vain, for I consider I had the good fortune to very soon come upon fossils presenting in many respects similar facies to the one in London; fossils, if not distinct from tree-root remains, can scarcely be shown to have once occupied such positions.

In the lowest workable coal-seam in the neighbourhood of Madeley and Hawley, about four miles to the east of Wellington, Salop, occur innumerable specimens of Stigmaria (? ficoides), not merely impressions of the exterior of the plant, as so very frequently observed by the writer upon the laminæ of coal, including cannel and anthracite, but as casts of what have the appearance of being individual plants chiefly composed of sandstone, but now and then of clay-ironstone or largely of pyrites mixed with siliceous material. From personal observation as well as from minute enquiries

* Dr. Hy. Woodward, F.R.S., tells me this fossil is not so labelled. —W. S. G.

made on the spot of those who are daily in a position to notice these fossils (I refer to the underground managers and officials at the collieries in the district), it seems that these fossils always lie horizontally, or in the plane of the seam, and have never been seen to cut obliquely across the grain of the coal. In shape and bulk they vary between about 4 inches and 2 feet (seldom less or more) in length, and in diameter or thickness from 2 to 7 inches; they are generally flattish. In form or shape they vary greatly, some being nearly straight, others bending in angles up to 80° or 90°, or possessing a twisted, crumpled, distorted, and even folded appearance. (Plate II., fig. 5.) Branched or forked specimens are not unfrequently found. (Plate II., fig. 6). Many of the smallest examples are of about the same bulk as a penny bun (Plate II., fig. 4), being nearly circular and from 1 to 2 inches thick. More rarely they assume a kind of double hooked or S shaped form, the twists being vertically nearly under one another, or the upper bend may be a foot or so (Plate II., fig. 5) distant from the lower bend ∽, such bends being turned a good deal to one side (horizontally). The various forms noticed are by no means easy to describe; they could be much more easily understood by the aid of short rolls of some plastic material such as clay or dough, which could be quickly worked up into the forms of these fossils were it necessary. Now, as regards the terminals of these fossil forms, all I can say is, that with many of them the ends are well and neatly rounded off, exhibiting more or less clearly the characteristic stigmarian markings (the rootlet-scars). With others, and probably with the majority of specimens, the case is somewhat different; their ends are either tapered down to nothing hardly, or the sandstone assumes an uneven or serrated surface, being interstratified with the coal, so that we lose the original form of the fossil, either from its being impossible to separate the coal from the stone, or because the fossil has been forced out of shape. Specimens possessing well-defined terminals, therefore, are difficult to extricate from the coal. As is usual with almost every specimen of Stigmaria we meet with, these Salopian examples show the rootlet-scars more clearly upon one side than upon the other, and in common with most others, possess little, if any, remains of internal organisation. They merely possess the external markings already alluded to, and sometimes indications of the central axis (medullary cavity or a vascular cylinder). Their position in the coal seam varies, being in one place most numerous in the upper portion, in another in the middle, and now and then chiefly in the lower portion, whilst in some

localities they appear to occupy positions in all layers of the seam as well as to extend to the roof.

In some places these things are so numerous as to make the coal unworkable.

The name of the coal-seam is the "Little Flint," and below is a section showing its thickness, &c.

	FT.	INS.
Sandstone giving place to Shale towards north and east. - - - - -	varies.	
Little Flint coal-seam with many Stigmaria, about - - - - - - -	2	9
Hard grey Sandstone, without fossils, about	4	0
Coal, called "Lancashire Ladies" - -	a few ins.	
Blue Shale - - - - - -	varies.	

That the Stigmariæ in this (Little Flint) coal-seam are remarkable would seem clear from the fact that, so long since as 1833, Prof. Prestwich called attention to them in his memoir on the Coalbrookdale Coalfield (see "Trans. Geol. Soc.," second series, Vol. V., page 441). It would appear that he then regarded these fossils as plants distinct from trees, as he used the term "stems" when describing them.

From what I could learn in the district, such a thing as any approach to fossils showing the connection of Stigmaria with a tree stump, has never yet been met with in this coal, notwithstanding hundreds of fossils are turned over with and separated from it every day. Surely this fact is of great importance!

In the Leicestershire coal-field is a seam called the "Eureka" coal, which, by the way, occupies very nearly, if not, the same horizon in the measures as the Little Flint does in those of Coalbrookdale, Now, in this coal-bed are found Stigmaria fossils in almost the same way as at Coalbrookdale (Plate II., fig. 3), being identical in shapes and in bulk, but not often met with excepting close to the top of the coal. They are invariably, I am informed, completely imbedded in the seam. and have not been observed turning upwards into the roof and assuming the form of the stool of a tree—forms commonly known in the mines as "pot-bottoms" or "pot-holes." All these Leicestershire (Eureka coal) specimens, like their neighbours in Salop, are sandstone casts, and exhibit next to nothing in the way of internal structure.

I have also come upon similar short lengths of Stigmaria with rounded terminals, some of which resemble, in some degree, those of the South Kensington Coalbrookdale individual, in the Derbyshire coal-field at Glapwell Colliery, where, as the manager and the men tell me, they always "run

out to nothing at both ends."* (Plate II., figs. 4 and 7.) Again, it should be remarked that a flattish circular clay-ironstone specimen, about 4ins. across, was found by myself, in August last, on a pit-bank near Mangotsfield, in the Bristol coal-field.

All this points to the conclusion that these particular forms of Stigmaria are exceedingly common, at any rate in certain areas. Believing, as I firmly do, that almost every Stigmaria specimen we find has lived and died on the spot, though some may have been transported along with the vegetable matter in which they had root to greater or less distances; and that as they occur in sandstone, in coal, in cannel, and black carbonaceous mud (shale), and in clay (underclay), it seems perfectly clear that the plant, whether the tree-root or other type, did not find the material of which underclays were or are composed *essential to its growth.* An ample supply of moisture would appear to have been the one thing needful for its support.

(d) On the strength, then, of the British Museum "terminal" specimen, and on the individual plant-like Stigmariæ of the Little Flint coal of Salop, the Eureka of Leicestershire, and of others found in Gloucestershire and Derbyshire, and also of what Lesquereux and the French school firmly believe to be the true reading of the fossil, I beg leave, in conclusion, to put the following questions, which, I maintain, must be fully and satisfactorily answered before it can be *positively asserted that in Stigmaria we have a root only.*

1.—Does the organic structure of Stigmaria, so far as made out, preclude the possibility of its being an individual plant; in other words, are we compelled, on botanical grounds, to give an unqualified rejection to a belief in a plant *sui generis?*

2.—As the material of these Salopian and other fossils in coal is usually sandstone, it will probably be argued by many that they are remnants of tree roots, which, during the existence of the stump became filled up with sand even to their very extremities. Are we not equally justified in assigning another cause or explanation of the phenomenon—namely, that these things have become sandstone much in the same way as the large nodular masses of pyrite often found in coal, or as those Stigmariæ which are composed of clay-

* These occur just at the top of the "Top-hard" coal-seam (5ft. 6ins. thick), and what is remarkable about them is that I am told they always lie with their longer axis more or less N. and S. or parallel with the "cleat" or master-joints of the coal, "end on" as the mining term is.—W. S. G.

ironstone, or occasionally wholly of pyrite, have been formed? In short, are they not just as likely to be of concretionary origin (replacement of organic vegetable matter by iron), as they are to be due to infilling from the roof of the seams? *

3.—With regard to the shape of the fossils: Do not their rounded-off terminals (resembling in many cases that of a cucumber), as well as the peculiar serpentine or folded aspect of many of them, demand some other explanation of their form than that which supposes them one and all to be the result of chemical alteration combined with pressure brought on during solidification of vegetable matter into coal? (Plate II., figs. 2 and 5.)

4.—Had these Stigmariæ been tree roots, how is it that all traces of the stems or stools have disappeared? Why were none of them preserved as sandstone casts if that were the case with the roots?

5.—Another botanical point: Is it not just as logical to say:—As Stigmaria was the root of at least two different trees (Sigillaria and Lepidodendron), and that as Lepidodendron branches sometimes terminated in Halonia, what is there to prevent us from allowing that Stigmaria may *sometimes* have existed without any upright or aërial stem at all?

6.—In regard to beds of coal: Inasmuch as it does not appear that the roots of Sigillaria, &c., have been shown to be Stigmaria from the study of specimens found in underclays; how can it be said that the Stigmaria-looking fossils in these clays had a similar organisation to the tree-root Stigmaria, or that they were ever *really roots at all*?

7.—In what other way are we to account for the fact of the Little Flint coal in Coalbrookdale resting, not upon an underclay, but directly upon a bed of sandstone in which it is stated there are no Stigmariæ at all, except we conclude that the coal did not commence to grow as a forest of trees, &c., or that it was an aqueous formation? †

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* It has always appeared a difficulty with me in accepting the idea held by many of us, that when we find Stigmariæ as tree-roots many yards in length, and in the shape of complete *casts* of the roots, composed entirely of Sandstone, the sand must of necessity have come in through the stump of the tree and found its way along the roots to their terminals, filling up the roots gradually *towards the stump*. That a decayed tree root, whether it grew in what is now coal or in sand, could be so filled, seems to my mind, an impossibility. I look upon these fossils as having been formed by infiltration of siliceous matter through their outer bark or coatings—a gradual replacement of wood tissue by mineral matters.

† Not necessarily transported by water, but certainly not grown on dry land.

8.—Seeing, then, that as Stigmaria does not occur below coal-beds in the shape of roots, and that we have strong grounds for supposing that it was not always a root, am I not perfectly justified in saying that, in my opinion, the fossils from Shropshire and other localities furnish forms the true character of which is impossible to be misunderstood? At all events I say this, that in absence of proof to the contrary, the Stigmaria question is not yet settled. If the specimens here brought under our notice are not considered good enough to set the matter at rest, it is hoped that better ones will soon be forthcoming.

9.—Do we not seem to have very good ground for concluding that *Stigmariæ* (? the tree-root types) were aquatic or water-loving plants, since they so frequently occur—evidently *in situ*—in cannel, a substance, I suppose, we all firmly believe to have been formed or grown in water (or at all events a kind of black vegetable slime or soft mud)? For instance, at Glapwell, in Derbyshire, no less than an area of 300 acres of cannel, varying in thickness between 2½ and 12 inches, has been proved to exist in the middle of the "Top Hard" coal —a seam averaging 5ft. 6in. thick. Stigmaria is common in this cannel.

10.—As Prof. Williamson says in his memoir on *Stigmaria ficoides*, "no plant should be regarded as Stigmaria unless its internal organisation is typically identical with that of *S. ficoides*;" it follows, does it not, that as the particular specimens I am describing in this paper have parted with their internal structure, and only possess the usual outward markings or *stigma* (rootlet scars), we have no proof that they were ever roots of trees at all? We are hardly justified even in concluding that they ever belonged to *S. ficoides*. It is surely by *inference* only that the two things can possibly be said to be one and the same fossil under different conditions!

11.—I should be the last to quarrel with those who assert that the tree-root type (Williamson's *S. ficoides*) may sometimes have become broken up under pressure or consolidation into short lengths, resembling, more or less, some of the forms I have here figured, but when we come across specimens so very numerous and so little resembling the *form even* of tree roots or fragments thereof, I do think we are dealing with a species differing from *S. ficoides* (Williamson).

THE FOUNDATIONS OF OUR BELIEF IN THE INDESTRUCTIBILITY OF MATTER AND THE CONSERVATION OF ENERGY.

A CRITICISM OF SPENCER'S "FIRST PRINCIPLES,"

PART II., CHAPTERS IV., V., AND VI.

BY J. H. POYNTING, D.SC., F.R.S.

(Concluded from page 11.)

Passing on from this, let us consider another experiment: that of the swinging pendulum described by Mr. Spencer. And to begin with, let us suppose that I set it swinging with a blow. It starts off in rapid motion, but as it rises up the motion gets less and less and ultimately ceases; only however for a moment. Back it comes on the return journey, and, when once more at the starting point, it is moving as nearly as I can judge at the original rate. Again it rises up, now on the other side. and with speed slackening till it stops; again it returns and so on, the oscillation continuing though the motion is intermittent. As Spencer points out, the motion of the pendulum is the objective correlate of our sense of muscular effort experienced in starting it, not, however, mere effort like the effort of holding a weight in a given position, but of muscular effort combined with motion, for we pushed the hand along in giving the pendulum the blow. It is unfortunate that we have no single sensation which we naturally correlate with the combination of effort and motion, but we all have the idea fixed firmly enough in our minds as work, and this is shown by the common use of the term. To take a familiar example. If bricks have to be carried up a scaffold, the work done is naturally measured by the weight of bricks multiplied by the height of the scaffold; or we think of this product, force × distance, as describable by the single term Work. Hence we say the motion of the pendulum is the objective correlate of the work done by us. Now as the motion disappears, does it go out of existence? and as it begins again, does it start afresh? Our continuity or identity postulate is ready at our elbows to suggest identity of the motion in succeeding oscillations, and we have a confirmation of the suggestion that it still exists, even when it disappears as motion, in the fact that if at the top of the swing we lay hold of the pendulum it pulls at our hands; it is ready in fact to give back to us work such as we gave to it. We conclude then that there is a continuity of existence, at one time showing itself as motion, and at another

manifested only in the pull exerted by the pendulum on the hand. That to which we assign continuity we term energy—kinetic when it shows itself as motion, potential when it is only inferred to exist from the position of the body and the knowledge of the work it will do. We may use as a symbol, to enable us to think of this potential energy, the energy of a stretched indiarubber cord. If a boy projects a ball attached to such a cord, the ball gradually loses its motion but the cord stretches, and in this state of stretch we suppose it to possess the energy previously in the ball. If we think of some invisible connecting machinery between the earth and the pendulum, we may conceive this machinery as stretched when the pendulum rests at its highest point, and as in that state possessing the energy lost as energy of motion by the pendulum.

So far I have closely followed Spencer's masterly analysis of this example, here and there replacing his terms by those more commonly used by physicists, but in his succeeding statements I can no longer go with him. Let us examine one or two of these statements. He argues that the sense of muscular effort is the subjective symbol both for force and for energy, though he recognises that in the latter case the feeling of effort is joined with consciousness of motion. It is true that when we exert mere muscular effort without moving our limbs, we do work and so lose energy and even become tired, but that is due to the particular mechanism employed. If we study the separate muscular fibres instead of the whole limb, we find that they are moving even when we are exerting only a dead pull or push without motion. And so our sense of effort probably accompanies a supply of energy to the muscles, and our feeling of fatigue probably accompanies a loss or absense of energy. The combination of effort with motion uses up a great deal more energy and leads more rapidly to fatigue, but the fatigue is of the same kind in both cases. In the objective world, however, force and energy are entirely distinct. We speak of the steam pressure in the boiler without confusing it with the horse power of the engine, one being force per square inch, the other energy per minute. We speak of the weight of a consignment of goods, and we admit the justice of the mileage rate of charge for its carriage by rail, one being force, and the other a charge proportional to energy expended in the carriage.

The physicists, through painful experience, aware of the extreme importance of keeping these two ideas of force and energy distinct, or rather of recognising that the one contains something over and above that which the other does, are

repelled by Mr. Spencer's attempt to reduce both to force. They recognise that our muscular sense is misleading inasmuch as it gives us a consciousness of loss of energy when we exert force alone, and only a consciousness of greater loss joined with an inadequate consciousness of motion when we do external work. They say that if effort be correlated with force it is a mistake to correlate it also with energy, and that if we do naturally so correlate it the correlation can only lead us astray.

Another statement which it is difficult to accept, is to the effect that the existence which we have termed energy, must show itself either as motion or as strain—*i.e.*, either as kinetic energy or potential energy. A system in which after any interval the kinetic energy comes back when the bodies are again in their original position is termed a conservative system, and it is of such a system alone that it is strictly accurate to say that the sum of the potential and kinetic energies remains the same. When and only when we have such a system are the forces persistent, *i.e.*, dependent only on the distances of the bodies apart. It is *supposed* (not, as Spencer says, *assumed*) that astronomy furnishes us with a grand example of a conservative system, inasmuch as our proofs of the indestructibility of matter lead us to suppose that the planets have constant masses, and our measures of their distances and motions show that when the distances repeat themselves the velocities recur. The masses being constant the energy must have all returned. But even in this case it is suspected that the forces are not quite persistent, though we have no certain proof of the fact.*

Terrestrial motions are all affected by friction, a sworn enemy to conservation, since by opposing the motions it always ends them without putting any potential energy in their place. Careful examination of cases of friction shows, however, that there is still a sign of the continuity of existence of that which for a time appeared as kinetic energy, and then on vanishing, led us to believe that it still existed as potential or strain energy. This new sign is heat—something affecting a new sense. Further study shows other signs—as light affecting the sense of sight—and chemical energy, sometimes perhaps affecting the sense of taste. Then in some cases the phenomena of magnetism and electricity are developed, phenomena which lead us to believe that there is latent energy

* I may here point out an error into which Spencer appears to have fallen, confounding the equality of action and reaction with persistence of force. One is a relation true at any instant, the other a relation true in successive instants.

ready to turn into heat, or kinetic or chemical energy in the electric circuit, latent since we have no electric or magnetic senses to detect it.

All these results lead us to believe in the truth of the principle of the continuity or identity of energy, a principle evidently founded on the identity postulate, since what we observe is that energy passes from one form and that simultaneously energy appears in another form, and that when it passes from this latter form we can obtain energy again in the original form. But this continuity does not necessarily imply constancy in quantity. That is another principle founded on experiment. Determinations like those of Joule tend to show that when energy changes from one form to another there is a fixed rate of exchange. If then, using the known rates of exchange, we suppose all energy converted into one form, experiment leads us to suppose that the sum total is constant.

We can now see in what sense it is true that energy must show itself either as kinetic or as strain. It is only true if we assume that light, heat, and the rest are either kinetic or strain energies or mixtures of the two.

This brings me to the consideration of another part of the work of the physicist.

His main work, as I have said, is the determination of resemblances or similarities, and he groups phenomena according to these. In the course of scientific work many of these groups are shown to resemble each other—one set of phenomena is shown to be a mere combination of phenomena already known, and the phenomena are then said to be explained. Thus Wells showed that in the deposition of dew there is a cooling of the earth's surface, cooling therefore of the moisture-laden atmosphere in contact with it, and deposition of some of the moisture. In other words, he showed that the deposition of dew resembled other depositions of water, and so he explained it. Or again, Faraday explained the formation of electricity by the jet of steam in the hydro-electric machine when he showed that there was friction between the drops of water carried by the steam jet, and the sides of the orifice past which they rushed, that the two were oppositely electrified, and that it was therefore similar to other known cases of electrification by friction. And numberless other instances might be given.

But the physicist is not content with explanations which he can prove. He is an inveterate builder up of hypotheses for the most part unverifiable, but that hardly troubles him. His hypotheses are always attempts to imagine such a

condition of affairs that he may continue the work of explanation, *i.e.*, of detection of hidden similarities. For instance, a solid body is, to our senses, a continuous something entirely filling up a space. If it is heated it expands; if it is soluble in water, it disappears when put in water. If we make no hypotheses, we can go no further. The expansion of a continuous solid is unlike anything else, and is therefore inexplicable; but I hold—and here I think Mr. Spencer would consider me quite hopeless—that there is no difficulty whatever in conceiving of the expansion of continuous matter. Again, the disappearance of the continuous salt in continuous water is inexplicable, but I have no sense warrant that it is not going on, and I may be driven to attempt to conceive it. But now let me introduce the unverifiable, or, at least, unverified, hypothesis that matter is discontinuous, and really consists of separated particles, and I can explain expansion:—it resembles the scattering of a crowd. I can explain solution:—it resembles the mixing of two crowds, and so on.

Again, we have recognised various forms of energy—kinetic, affecting the sight in one way, or light affecting it in another way, or heat affecting the temperature sense, but we cannot say that any one of these resembles any other. Without hypothesis they are inexplicable. But, let me suppose that the ultimate particles of matter possess both strain and kinetic energy, and that, when they bump against my skin, they affect my temperature sense, and I explain heat. I show that a hot body resembles known mechanical systems. Or, let me suppose that even where I cannot see or feel matter there is still something which can be acted on by the ultimate particles of matter and receive energy from them, and I can explain light as being waves sent out in this intangible something by the vibrating atoms. I show that it resembles other cases of waves sent out from vibrating sources in water or in air.

No doubt this longing for explanation which possesses us is in part strengthened by our belief in identity. If energy is continuous in its existence, then we suppose that in itself it must be the same in kind, though now it affects one sense, now another, and now none at all. We go on from this another step and suppose that if we could only train our senses sufficiently we should be able to follow the energy through all its transmigrations, and see it ever the same in kind. The senses used in the investigation of visible motion, the muscular sense, the touch, the eye, are the most thoroughly trained, and work best together. We, therefore, naturally fix on these as the senses which are, in imagination, to follow the energy up, and so our hypotheses are constructed

to enable us to explain all phenomena as cases of mechanical action and mechanical motion—to explain all the forms of energy as kinetic and potential.

As yet, our hypotheses are unverified, and, for the most part, they appear likely to remain so, for it is difficult to conceive of any test of their truth. And until they are verified we must ever bear in mind that new hypotheses may at any time be devised, which may explain phenomena even better than the old ones. So, it behoves us to be cautious in committing ourselves to doctrines as to the indestructibility of matter or the continuity of motion, which are based on hypotheses as to the structure of matter and the nature of energy. We need have no fear that without these doctrines science would be impossible. If matter is destructible and motion ceases, there is only the more work for the physicist to do in determining the conditions of annihilation. He can still find resemblances, can still explain the complex unknown as made up of the simpler known. And when his senses fail to guide him, he can still invent hypotheses whereby his imagination may come to their aid. His science will only stop when he comes to the ultimate ideas, the inexplicables, in terms of which all phenomena are to be described—inexplicables, in that they can be no further resolved, in that they are utterly unlike each other but not unknowable, for we know them one from the other, and we know them as the threads with which is woven all that we have yet discovered of the pattern of the universe.

But this is not an exposition of Mr. Spencer's chapters. I seem to have travelled so far on a diverging path, that I have almost lost sight of the goal to which he would lead. Let me attempt, in conclusion, to state in a few words where I think we diverged.

While Mr. Spencer holds that common experience of matter and motion, if rightly interpreted, leads to the belief in the indestructibility of the one and the continuity of the other, I hold that common experience only raises a presumption, the belief is only rightly and firmly founded on the results of careful and exact quantitative experiments. While he holds that they are necessary truths, I still think it conceivable that they are false. While he regards them both as leading to the persistence of force as the ultimate postulate, I very much doubt whether any relation between definite ideas is a postulate. The postulates which I have used are both of them conditional propositions. If so and so, then so and so. In fact, I suspect that the mind is provided only with machinery ready to arrange the results put into it by the senses, and that it does not contain any results ready made.

NOTES ON A TOUR IN NORWAY AND COLLECTION OF PLANTS.

BY W. P. MARSHALL AND C. PUMPHREY.

(*Concluded from page 6.*)

In Hooker's standard account of the Arctic Flora (Transactions, Linnean Society, Vol. XXIII., p. 251), the North of Norway and Lapland, a district of which the North Cape is the the central point, is described as containing by far the richest Arctic flora, amounting to three-fourths of the whole; moreover, upwards of three-fifths of the species and almost all the genera of Arctic Asia and America are likewise Lapponian, or belonging to this Lapp district.

The striking fact was brought out by Hooker that this Lapponian Flora is the most widely distributed flora over the earth; it not only girdles the earth in the Arctic Circle, but dominates over every other flora in the North Temperate Zone of the Old World, and intrudes conspicuously into every other temperate flora, and has even migrated into southern latitudes. The greatest number of Arctic plants are located in Central Europe, no fewer than 530 out of 762 inhabiting the Alps and Central and Southern Europe.

Hooker considers this fact can only be accounted for by Darwin's hypothesis that the existing Lapponian Flora is of great antiquity; that during the advent of the glacial period it was driven southward, and even across the tropics into the Southern Temperate Zone; and that on the succeeding warmth of the present epoch, those species that survived ascended the mountains of the warmer zones, and also returned northward, accompanied by aborigines of the countries they had invaded during their southern migration; their present distribution being accounted for by continuous slow changes of climate during and since the glacial period.

The following is a list of the plants collected in this Norway Tour:—

NORWAY PLANTS COLLECTED JULY-AUGUST, 1888.

Ranunculus acris	M.	Sisymbrium sophia	Vk.
,, aconitifolius ..	V.F.	Draba incana	Vk., L.
Trollius europæus	N.C.	Cochlearia officinalis	N.C.
Aconitum septentrionale ..	R.	Braya alpina	L.
Arabis thaliana	E.	Capsella bursa-pastoris ..	L.
,, hirsuta	N.C.	Viola Riviniana..	R.
,, alpina	E., N.C.	,, tricolor	Tm.
Cardamine amara	Tm.	Drosera rotundifolia	Vk.
,, pratensis	U.	,, anglica	So.

Polygala vulgaris	E.
Dianthus deltoides (?)	R.
Silene rupestris.. ..	J., L., R.
,, acaulis	N.C.
Lychnis dioica	Tm.
,, flos-cuculi	E.
Sagina nodosa	L.
,, nivalis	Vk.
Stellaria graminea	E.
Cerastium alpinum	N.C., R., Nb.
Spergula arvensis ..	Vk.. L.
Hypericum perforatum ..	Vs.
Geranium pratense	Tm.
Lotus corniculatus	Tm.
Anthyllis vulneraria	Tm.
Vicia cracca	R.
Lathyrus pratensis	Sv.
Spiræa ulmaria	M.
Alchemilla vulgaris	B.
,, alpina	R.
Potentilla rupestris	Tm.
,, tormentilla ..	Tm.
,, anserina	Vk.
Comarum palustre	M.
Rubus chamæmorus ..	Vk., Tt.
,, arcticus	Tm.
,, saxatilis	Tm.
Dryas octopetala ..	N.C.
Geum urbanum..	M.
,, rivale	Tm.
Pyrus padus	Tm.
Epilobium alpinum	Vk.
,, montanum ..	Tm.
,, angustifolium ..	Vk.
Circæa alpina	E.
Sedum annuum.. ..	Vk.. R.
,, Rhodiola	N.C.
,, sexangulare	Sv.
Saxifraga oppositifolia ..	N.C.
,, aizoides	Nb.
,, cotyledon	R.
,, cæspitosa	N.C.
,, stellaris	V.F.
Parnassia palustris	L.
Carum carui	Tm.
Cornus suecica ..	Sv., L., Tm.
Viburnum opulus	Tm.
Linnæa borealis	M.
Galium saxatile	Tm.
,, verum	L.
,, boreale ..	J., Nb.
Aster tripolium	M.
Erigeron acris	R.
,, alpinus	R.
Solidago virga-aurea	Vk.
Gnaphalium supinum ..	J.
,, sylvaticum ..	E.

Antennaria dioica (male) ..	Tm.
,, ,, (female) ..	E.
Arnica montana	Vk.
Pyrethrum inodorum ..	Vk.
Cotula coronopifolia	L.
Chrysanthemum leucanthemum	Tm.
Centaurea jacea	J.
Apargia ——	Tm.
Mulgedium alpinum (Sonchus)	V.F.
Crepis virens	Vk.
——— tectorum	Vk.
Lobelia Dortmanni	Vd.
Campanula rotundifolia ..	U.
Andromeda polifolia	M.
Erica tetralix	M.
Menziesia cœrulea	Nb.
Loiseleuria procumbens ..	N.C.
Vaccinium uliginosum ..	Tm.
,, Vitis-idæa.. ..	Sv.
Pyrola secunda	L.
,, rotundifolia	Sv.
,, uniflora	Nb.
Gentiana campestris	L.
Mertensia maritima	Sv.
Myosotis arvensis	R.
Verbascum pulverulentum ..	L.
Linaria vulgaris	L.
Scrophularia nodosa	Vk.
Pedicularis sylvatica	Vk.
Euphrasia officinalis	Vk.
Veronica chamædrys ..	Tm.
,, beccabunga	Tm.
,, officinalis	Tm.
,, saxatilis	Vk.
Galeopsis versicolor	Vk.
Pinguicula vulgaris	Vk.
Trientalis europæa	Tt.
Statice armeria	Sv.
,, danica	N.C.
Rumex acetosella	Nb.
Oxyria reniformis	Nb.
Polygonum viviparum ..	Sv.
Empetrum nigrum	U.
Salix retusa	Nb.
Orchis conopsea..	E.
,, mascula	J.
,, maculata..	Vk.
Gymnadenia conopsea var. densifolia	R.
Habenaria bifolia	Sv.
Maianthemum bifolium (Smilacina)	M.
Tofieldia palustris	Sv.
Narthecium ossifragum ..	Vk.
Juncus acutifolius	M.

Eriophorum alpinum.. ..	Nb.
,, polystachyon ..	J.
Carex echinata	M.
,, umbrosa (præcox) ..	E.
,, atrata	N.C.
Phleum pratense	Sv.
,, alpinum	Nb.
Poa Schlerochloa	L.
,, alpina	R.
Festuca ovina	Tm.
,, rubra	M.
Equisetum sylvaticum ..	Tm.
,, palustre	N.C.
Polypodium calcareum ..	R.
,, vulgare, var. acutifolium ..	Vk.
Woodsia ilvensis	R.
Polystichum lonchitis ..	R.
Asplenium trichomanes ..	E.
,, septentrionale ..	R.
Lycopodium selago	
Lycopodium annotinum ..	
,, clavatum ..	
Polytrichum commune ..	M.
Sphærophoron coralloides ..	L.
Lecanora ventosa	L.
Cladina rangiferina (Reindeer Moss) ..	L.
Cladonia furcata (Reindeer Moss) ..	L.
,, gracilis	L.
,, cornucopioides ..	L.
,, uncialis var. humilior ..	L.
,, digitata	
Lecidea contigua var. meiospora ..	
Parmelia physodes	
,, saxatilis	
Ricasolia amplissima	
Cetraria Islandica var. crispa (Iceland Moss) ..	

REFERENCES TO THE LOCALITIES WHERE THE ABOVE SPECIMENS WERE TAKEN :—

B. Bergen.
M. Molde.
Tm. Throndhjem.
Tt. Torghatten.
Sv. Svartisen.
N.C. North Cape.
R. Romsdal.
Vs. Vestnaes.
So. Soeholt.
U. Utvik.
Vd. Vadheim.
L. Laerdalsoren.
J. Jostedal.
Nb. Nigaards Brae.
Vk. Vik.
V.F. Voring Fos.
E. Eide.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Concluded from page 16.)

ADDITIONAL REMEDY.

The additional remedy I have to propose has been already very explicitly described in previous pages, and so the details need not be given here. Briefly it consists in giving facilities for flood-water to get into the river gravel, which almost everywhere underlies the present river bed and stretches to a good distance on each side of it, and in providing *dumb-wells* or *swallow-holes* for this river gravel to drain into a good water-bearing bed below. from which Northampton and other towns and villages might be supplied with water. It does not aim so much at preventing floods as providing water;

nevertheless, it would prevent the smaller floods, and mitigate the larger, allowing them to do the maximum amount of good, and less harm than they do now. Below is a summary of the advantages likely to result from the application of this method :—

1.—The river gravel of the Nen, with its cap of alluvium, naturally represents the former extent of the river when in flood, and now approximately coincides, in superficial extent and position, with the area subject to floods. The average depth of the gravel is almost certainly greater than the average depth of flood-water, therefore, if the flood-water at any time present on the ground had free access to it, and found it empty, such water would be wholly or nearly disposed of, and the whole flood greatly reduced in intensity. The dumb-wells, constructed for other purposes, would tend to keep the river gravel empty, and access to the gravel would be greatly facilitated by the various devices already proposed, and so a great quantity of water completely prevented from doing harm, particularly if the river were connected with the gravel. Not only would the river gravel act as a reservoir, but it would be continually emptying and making room for more water, to the extent the dumb-wells are able to receive such water.

There need be no fear of the gravel being over-taxed as a filter, for within the area dealt with, there would be almost as many square miles of filtering material as acres would be required for the assumed maximum capacity of the dumb-wells, at the rate of $1\frac{1}{2}$ square yards for each 1,000 gallons in twenty-four hours, or a descent of about 6 inch per hour.

2.—The water disposed of would not be lost to the district, and if used as this scheme suggests, it would be returned to the river in a pretty regular volume, after having served some useful purpose. I find that the utilisation of the river gravel as a temporary reservoir for flood-water was suggested some years ago by Professor Prestwich.* The suggestion arose out of a proposal to construct impounding reservoirs along the Thames Valley for the same purpose. Professor Prestwich's remarks were about as follows :—The Thames and Cherwell were liable to floods of such magnitude that, however useful storage reservoirs might be in providing additional water in times of drought, no practicable extent of storage could prevent floods. Large reservoirs, in fact, already existed, compared with which any artificial reservoirs

* "Rainfall and Evaporation," by Symons, Greaves, and Evans. Discussion on the Papers. Proceedings of the Institute of Civil Engineers, 1876.

which could be constructed would be insignificant. In the neighbourhood of Oxford the valley spread out to one to one-and-a-half miles for a distance of four or five miles, giving an area of some 3,000 acres. Both lower down and higher up the valley a succession of similar basins existed, in all of which the alluvial clay was underlaid by a bed of gravel, varying from five feet to twenty feet in thickness, and the water in this was held up by impervious beds below. Some drainage works at Oxford, in which the main drains were laid at a depth of about sixteen feet for a distance of two miles, permitted a study of the conditions here. It was noticed that at the bottom of the gravel there was always sufficient water to supply the wells to a village of 700 inhabitants, standing in the middle of the valley, and to supply the adjoining reservoir for the water-works of Oxford; also, that as rain continued, the water gradually rose in this gravel up to and above the alluvial clay, and then floods ensued. It was thought probable that these natural reservoirs might be utilised for the storage of winter rain by damming back at the narrowest parts the water held in the gravels of the larger basins, and so arranging that the water could be discharged at lower levels down the river in periods of drought.

3.—It would render possible the drainage of districts in which it is now practically impossible, because (except by the expensive expedient of carrying the drains to lower parts of the river) there is nowhere to drain into, the meadows being really below the level of the water in the river when the latter is moderately full. If drainage is necessary for uplands, how much more so is it for lowlands? And if it brings all the advantages attributed to it, the benefits to be derived from this scheme must be very great.

4.—The lowlands would still have the advantages of flood water in the shape of manure and fine silt from the uplands, which now renders ordinary manuring unnecessary. Also the meadows would be well irrigated without the serious disadvantages arising from stagnant water. There are some places along the Nen Valley where a comparison between the moving and stagnant water of floods may be made. On the south side of the valley, near to Great Houghton, for instance, the river gravel is not overlaid by alluvium, and the land is about a foot higher than on the north side of the valley; the consequence is the water runs away into the gravel very rapidly, and every flood seems to enrich these meadows, whereas on the opposite side of the river, in the parish of Abington, exactly the contrary effect is produced.*

* "Drainage of the Nene Valley," by Rev. Chas. Hartshorne. Report of John Beasley, Esq.

5.—*The land would be rendered much more valuable for grazing purposes*, for the herbage would be improved; the period during which it could be stocked lengthened by perhaps two or three months; and diseases of cattle, and rot in sheep in particular, would be much less likely to occur. It is not uncommon, under the present condition of things, for fields to be covered with water continuously for 12 or 13 weeks in the year.

6.—*The climate would be locally improved.* At some periods of the year, when there is little wind, it is very noticeable how a bright warm morning brings a dull or even wet afternoon and evening, followed again by a clear night. This is very harassing to farmers, and from observation of such occurrences I have been led to infer that in these circumstances the clouds are locally formed, by the rapid evaporation from large surfaces of flood water, or wet lands. With dryer lands and less surface water this would be less likely to occur. It is a fairly common belief that the moon has some particular power to disperse clouds, because a fine night will often follow a dull day; there is very little doubt that just the opposite is the case, the night is fine because of the impotency of the moon to cause evaporation and produce clouds.

The effect on the health of human beings and cattle would be decidedly beneficial. A malarious atmosphere is created not by water, but by the action of the sun on decaying vegetable matter, and such there will very frequently be where land cannot be drained. Ague, once so common in the Fen districts, has now nearly disappeared through drainage; only droughts in autumn now are likely to occasion it.

Conclusion.

The water scheme that has been described in these pages embraces a small district only, and proposes to deal with a comparatively small quantity of water, but the principle admits of very general application, and there are signs that it is receiving attention from water engineers.

Water is not manufactured in the ground, neither is there an inexhaustible supply there, but it all gets in from the surface somewhere; it follows, therefore, that the continuance of underground sources is a matter of rainfall and percolation.

The rainfall of this country varies from something like 165 inches in the Lake district to 20 inches in the East Midlands, and the average for the whole country is rather over than under 30 inches, an amount quite sufficient for all purposes of human consumption, manufactures, and maintenance of rivers and canals; yet water is scarce, and all

modern improvements in country and town tend to make it more so, both because more water is used, and special facilities are given for the water not immediately required to find its way into the main streams, sometimes polluting them, and sometimes causing them to overflow.

Of course the rapid removal of all stagnant surface water is highly desirable, and in a country like England, the atmosphere of which usually has plenty of moisture in it, a diminution of evaporation from any cause is distinctly beneficial, but the rainfall need not necessarily be such an enemy as most modern drainage schemes seem to imply.

Floods always have been, and probably always will recur at times. The truth of the first of these propositions is evident from the great lateral extension of the river gravel, or alluvium, or both in most river valleys; and of the second from the inability to provide means whereby the drainage of a large area may be made to pass sufficiently fast into the porous beds underlying a much more limited one, when the rainfall is heavy; or be discharged sufficiently fast by the ordinary bed of the stream.

Rainfall does serve many useful purposes; it washes the atmosphere, feeds rivers and lakes, sinks into the ground and forms springs, flushes drains, and generally cleanses towns, but when it gets into situations where it can and does do damage, it is too often permitted to do it without exacting any equivalent of useful work from it. This arises partly from two sets of persons not acting together; some people want water, others want to get rid of it, by mutual agreement they might both be more completely satisfied.

Mr. De Rance estimates that there is an area of 26,633 square miles of superficial permeable rock in this country, and 19,308 square miles of impermeable with permeable underneath, and he has suggested that the latter area should be fed by means of *dumb-wells*, both to prevent devastating floods and yield water.

I would suggest that where permeable beds can be supplied in the manner I have proposed, that is by the intermediation of any superficial beds of gravel or sand—the river gravel or drift for instance—that would be the better plan. The supply of deep-seated water, from a given drainage area, would be much greater than if the outcrop of the water-bearing bed had been enlarged to an equal extent, and left as we now usually find it, covered with soil, and perhaps with provision for surface or under-draining. Further, innumerable small sources of water might be made available, and preserved as it can never be in open reservoirs, and this at less cost than by any other system.

The loss from floods all over the country has been greater of recent years than before, because of the higher cultivation of the land. This consideration alone suggests increased necessity for dealing with the question, and although some lands do not readily admit of the chief remedy proposed in these pages, it has been at least shown that some do, and these latter would not only be subject to less injury, but be better than they have ever been, hence the principle ought to receive as much support from owners and occupiers of land subject to floods as from the corporations of towns needing water.

A NEW BOOK ON LEAF-FUNGI.*

BY W. B. GROVE, B.A.

For a long time the British workers on "Leaf-Fungi" have laboured under the greatest difficulties. With the exception of those who had access to Winter's "Kryptogamen-Flora," and a few isolated magazine articles, they have been left entirely in the dark about the great advances in knowledge obtained in recent years by those who have worked at the biology of this group. Bare descriptions of species are not knowledge, although they are the first and necessary preliminary thereto. But now, thanks to Mr. Plowright's monograph, for the first time those mycologists who are confined to English books may enter upon the work of the year, with regard to Leaf-fungi, fully equipped for understanding the characters and the relations of the species they meet with.

These relations are now shown to be far less simple than had ever previously been suspected. The triumphant establishment of *heterœcism*, in which (*pace* Mr. Massee) I still think Mr. Plowright has taken no mean share, has not only demonstrated that those leaders of mycologic opinion in this country who so long and so obstinately pooh-poohed it, were incapable of appreciating the evidence, but has also made it clear that the intermingling and intercrossing of species and host-plants is so complex that nothing but persistent artificial cultures can ever disentangle them.

As an example we may take the species of Puccinia which grow upon *Phragmites communis*. These were formerly

* A Monograph of the British Uredineæ and Ustilagineæ, with an account of their Biology, &c., by Charles B. Plowright. London: Kegan Paul, Trench, and Co., 1889, pp. 348, and eight plates; price 10/6.

confused together; there are now known to be three:—*Puccinia phragmitis* (=*P. arundinacea*), the æcidia of which grow upon *Rumex conglomeratus*, *obtusifolius*, *crispus*, *Hydrolapathum*, *Rheum officinale*; *P. trailii*, the æcidium of which is confined to *Rumex acetosa*; and *P. magnusiana*, which has its æcidia on *Ranunculus repens* and *bulbosus*. But this is not all. An æcidium also occurs on *R. bulbosus* which is scarcely distinguishable, morphologically, from the one just mentioned, but which belongs to a Uromyces having its teleutospores on *Dactylis glomerata*, and another Uromyces, having its teleutospores on species of Poa, has its æcidia on *R. bulbosus* and *repens*, as well as on *R. Ficaria*. Still further to complicate matters, another Uromyces occurs upon *R. Ficaria*, which has been proved to have no connection with the æcidium upon the same plant. Once more, there is still another Uromyces which grows upon all the species of Rumex mentioned above (including *R. acetosa*), but which has no connection at all with any of the other parasites. Finally, the æcidium on *Ranunculus acris*, which used to be undistinguished from those on the other *Ranunculi*, is found to belong to a species (*Pucc. perplexans*), which it was reserved for Mr. Plowright to discover.

It must be remembered that all these statements have been proved by experimental cultures, in which not only the positive results must be regarded, but also the negative results obtained in the various methods of "control" cultures. The latter, indeed, are far more convincing than the former. If, on sowing the spores of an æcidium on another plant, we obtain a Puccinia, the result may be put down to chance, and was explained in this way by the older school. But if, in a series of similar experiments, we find that the Puccinia invariably appears where we have sowed the æcidium, and invariably does not appear (if proper precautions be taken) where the spores of the æcidium have not been applied, the conclusion that the one is produced from the other becomes very probable. If again, on sowing the promycelial spores obtained from the Puccinia on a suitable host, we invariably get the æcidium with which we started, and don't get it (under similar conditions) when the Puccinia has not been applied, the demonstration is complete. When these results are confirmed by hundreds of experiments made by observers of different nationalities, it is mere fatuity to doubt any longer.

I have been led into this digression because undoubtedly the chief value of Mr. Plowright's book lies in its biological aspect, but it is also an enormous advance upon all previous English works in its morphological descriptions, which may be

regarded as "Winter"—improved. There are a number of good woodcuts, and eight excellent plates, lithographed by Messrs. West, Newman, and Co., most of which are made from the author's original drawings. The typographical arrangement is especially neat and convenient. The book is well indexed—that of "host-plants" being particularly useful—and will be simply indispensable to all students of Leaf-fungi in this country.

Wayside Note.

FRESH WATER LIFE.—While examining some specimens of *Carchesium polypinum* and *Vorticella nebulifera*, I noticed a peculiar feature in them I had never seen before, although I have had them under the microscope on and off for years. I allude to a number of thin, long, transparent filaments clothing the pedicels of these creatures, notably the *Carchesium*. Some were quite thick with these aforesaid filaments. Whether anyone else has noticed them I do not know; but certainly I have seen no notice or sketch of them in any of our manuals. I have thought them worth just a passing notice. I may add that I have only at present seen the filaments on specimens from one place. They much reminded me of the transparent thin filamentous rootlets so commonly seen in *Nitella flexilis* and others of the Characeæ.—E. H. W., Edgbaston.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION. The 100th meeting of this section was held on November 27th, Mr. W. R. Hughes, F.L.S., in the chair; nineteen members present. Mr. Bagnall exhibited for Mr. Hughes thirty-one species of plants from Cobham Lane, Kent. For Miss Gingell, *Echium vulgare*, *Viola Reichenbachiana*, and *Polygala vulgaris* from Dursley. For himself, *Ulex Gallii* and *Ag. cyathiformis* from Corley Rock. Mr. Hughes exhibited a leaf of a Virginian creeper from the back of Dickens's house; also a new photograph of Mr. Herbert Spencer. Mr. Stone exhibited the skull of a marmoset, an echinus, *Phyllacanthus imperialis*, a large beetle, *Hylotrupes dichotomus*, from Japan, and pseudomorphs of *Ammonites tuberculatus* and *A. lautus* in iron pyrites, from Lyme Regis. Mr. W. P. Marshall, M.I.C.E., read his paper on "Modern Railways," illustrated by a number of maps and diagrams.—SUPPLEMENTARY MEETING, December 6th, 1888, Mr. W. R. Hughes, F.L.S., in the chair; eight members present. It was proposed by Mr. A. Browett, seconded by Mr. Stone and carried, that the dates of the supplementary meetings be altered from the 1st and 3rd Thursdays in the month to the 2nd and 4th. Mr. Stone exhibited the wing of the eucalyptus leaf insect which simulated the leaf of the eucalyptus so perfectly as to deceive even an experienced eye; the midrib and minor veins being accurately reproduced. Miss Goyne read the latter portion of the eighth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Transformation and Equivalence of Forces."

THIRTIETH ANNUAL REPORT

OF THE

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY,

Presented by the Council to the Annual Meeting,
February 5th, 1889.

The Council is pleased to be able to report that the Society has fully maintained its position during the past year 1888; the standard of the papers read and the attendance at the meetings having been well kept up. It is encouraging to notice that this year again confirms the expectation that the loss of members owing to the raising of the subscription has now practically ceased.

A Conversazione was held on October 30th, similar to the one at the opening of the Session in the previous year, and it proved very satisfactory, and was carried out at very small expense. It was held in the Examination Hall, Mason College, and amongst the exhibits were a fine case of Pallas's Sand Grouse, prepared by Mr. Chase; an interesting series of glass photographs, and a collection of objects under microscopes.

An Excursion to Dovedale was taken on Whit Monday; the party driving from Derby through Ashbourne to Dovedale, where they were kindly received by the Rev. W. H. Purchas, Vicar of Alstonefield, who conducted the party about the Dale.

The eleventh Annual Meeting and Conversazione of the Midland Union of Natural History Societies was held at Northampton on July 4th and 5th; Mr. W. R. Hughes and Mr. W. H. Wilkinson attended as the delegates from this Society. The meeting was held in the Town Hall, the chair being taken by the Right Hon. Earl Spencer, K.G., and an address was given by the Rev. H. H. Slater, F.G.S. The Darwin gold medal was awarded to Mr. J. E. Bagnall, A.L.S., for his "Flora of Warwickshire." On the following day excursions were made to Fawsley Park and other places of interest in the district.

The treasurer's annual financial statement shows the receipts of the Society for the past year to have been £153 1s. 6d., and the payments £152 9s. 5d., including the repayment of one of the six £10 loans, and leaving a balance due to the treasurer of £1 5s. 5d., instead of £1 17s. 6d. at the end of the previous year. The receipts for the year have more than covered the expenditure for the year, leaving a surplus to pay off the above loan; and the Council now

appeal earnestly to the members for their assistance in paying off more of the loans during the present year, by increasing the income of the Society through obtaining additional members. By an alteration recently made in the Laws, ladies can now become members of the Society on the same terms and with the same privileges as family members, by the payment of half-a-guinea per year; and it is hoped that this will lead to an increase in the number of lady members.

The total number of members for the year 1888 is 201, being 7 less than in the previous year (3 ordinary members and 4 corresponding members); of the total, 7 are life members, 145 ordinary (guinea) members, 12 family (half-guinea) members, 5 lady (half-guinea) members, 5 honorary vice-presidents, 23 corresponding members, and 4 associates.

On the occasion of the retirement of Mr. Charles Pumphrey from the office of treasurer of the Society an illuminated address was presented to him, which was kindly prepared by the president, Mr. W. B. Grove.

The Council have to report that the negotiations which were begun upon the proposed amalgamation of this Society with the Birmingham Philosophical Society have been suspended.

MICROSCOPICAL SECTION (*Ex-officio:* President, W. B. Grove, M.A.; Secretary, W. H. Wilkinson).—During the year eight meetings of the section have been held, with an average attendance of fifteen; and the following communications have been made:—

March 6th.—"The Present and Future of Science Teaching in England, with special reference to Botany," by PROF. W. HILLHOUSE, M.A., F.L.S., being the retiring president's address.

May 1st.—"An Account of the Foraminifera dredged by the Society during the Oban Excursion in 1883," by MR. E. W. BURGESS, communicated by MR. W. P. MARSHALL, M.I.C.E. A fine slide of 67 specimens (illustrative of the paper), named and mounted by MR. BURGESS, was presented to the Society.

May 29th.—"On Kew Gardens and some of the Botanical Statistics of the British Possessions," by MR. J. G. BAKER, F.R.S., F.L.S., communicated by MR. J. E. BAGNALL, A.L.S.

June 6th.—"Notes on some Foraminifera collected and mounted by MR. E. W. BURGESS from material obtained near Oban by the Society during their dredging excursion in 1883." By MR. J. F. GOODE; illustrated by specimens in microscopes, and by a fine series of micro-photographs in the oxy-hydrogen lantern, by MR. J. EDMONDS.

The meetings of May 1st and October 2nd were devoted to Microscopical Soirées, and both were very successful. A large number of microscopes was exhibited by members representing all the sections of the Society.

At other meetings, Mr. W. R. Hughes exhibited a collection of flowers from the White Mountains, U.S.A.; Mr. W. B. Grove exhibited a number of fungi, both of the larger and smaller and minute kinds, some beautifully shown under the microscope, and amongst the many rare ones several were new to Great Britain; Mr. J. E. Bagnall exhibited many rare plants, both local and from a distance; Messrs. W. P. Marshall and C. Pumphrey, a collection of plants and mosses, which they brought from their tour in Norway; Mr. W. H. Wilkinson exhibited some very high Alpine plants from Scotland, a collection of lichens from Mount Stewart on the Island of Bute, also the lichens from the Northampton Excursion, and some very beautiful foreign species; Mr. R. W. Chase exhibited some birds, and gave an account of an ornithological excursion to the East Coast; Mr. Herbert Stone exhibited a collection of animal skins from Queensland; Prof. Harrison presented to the Society a fine sample of the polycystina earth from Barbados, which the members are now working out; Mr. C. Pumphrey exhibited photographs of flowers, &c., by the oxy-hydrogen lantern.

BIOLOGICAL SECTION (President, R. W. Chase; Secretary, J. E. Bagnall, A.L.S.).—During the past year the section has held eleven meetings, and owing to the industry and zeal of its members these meetings have been fully sustained in interesting and instructive matter. On eight of the evenings papers have been read, and on every evening there has been a good display of specimens, and the discussion arising thereupon has often been of great interest. The principal exhibitors who are members of the Society were Messrs. W. B. Grove, R. W. Chase, W. R. Hughes, W. H. Wilkinson, J. B. Stone, Herbert Stone, C. Pumphrey, C. Wainwright, J. Edmonds, W. P. Marshall, E. H. Wagstaff, and J. E. Bagnall. In addition to these we have been greatly indebted to the following non-members of the Society: Miss J. R. Gingell, Rev. T. Norris, Rev. D. C. O. Adams, and Father H. P. Reader. To Miss Gingell the section has been especially indebted for the trouble and expense she has been at in forwarding week by week abundant specimens of flowering plants, mosses, and fungi, from the district around Dursley, Gloucestershire. The attendance during the present year has been well sustained, the average being seventeen. The following is the list of papers:—

February 14th.—On "The Successful Use of Oil to Calm Rough Seas," by MR. W. P. MARSHALL, M.I.C.E.

March 13th.—"New or Noteworthy Fungi," Part IV., by MR. W. B. GROVE, M.A.

April 10th.—"Notes upon Birds which have become extinct, and those species which are likely to become so in Great Britain," by MR. R. W. CHASE.

May 8th.—"Notes on the Flora of Settle" (Illustrated), by Rev. W. HUNT PAINTER.

June 12th.—"Notes on some Plants of the Rhine Land," by MR. W. B. GROVE, M.A.

October 9th.—"Notes on Norway Plants recently collected by Messrs. W. P. Marshall and C. Pumphrey," Illustrated.

November 13th.—"Notes on the Corvidæ (Jackdaw, Raven, &c.)" (Illustrated), by MR. R. W. CHASE.

December 11th.—"The Salmon Fungus, 'Saprolegnia,'" (Illustrated), by MR. W. B. GROVE, M.A.

GEOLOGICAL SECTION (President, T. H. Waller, B.A., B.Sc.; Secretary, John Udall, F.G.S.).—Eleven meetings of this section have been held during the year, and have been well attended, giving an average attendance of twenty-one per meeting. The section is specially indebted to Mr. Waller for several valuable papers; to Professor Lapworth for a special paper on "The Red Rocks of the Birmingham District," and for his kindness in conducting an excursion of the section from Halesowen Station to the Clent Hills; and to Mr. C. Pumphrey for his assistance on several occasions in illustrating papers with his oxy-hydrogen lantern.

An interesting feature of the year's work was the invitation of the Vesey Club (Sutton) to one of the sectional meetings; this meeting was attended by Mr. J. B. Stone, Mayor of Sutton and Vice-President of the Vesey Club, and many of its members. A cordial invitation was given by the Vesey Club to the Geological Section to attend one of the Sutton Vesey Club meetings; such interchanges of courtesies are likely to bring forth much lasting good.

The following papers have been read at the meetings:—

January 17th.—"Notes on Serpentine Rocks," by MR. T. H. WALLER, B.A., B.Sc.

February 21st.—"Holiday Tours in Wales, &c." (illustrated by lantern photographs), by MR. C. J. WATSON.

March 20th.—"Holiday Tours in Switzerland and Germany," (illustrated by lantern photographs), by MR. C. PUMPHREY.

April 17th.—"Method of Separating Minerals by Heavy Solutions," by MR. T. H. WALLER, B.A., B.Sc.

June 19th.—"The Red Rocks of the Birmingham District," by Professor LAPWORTH, LL.D., F.G.S., F.R.S.

October 16th.—On "Rock Specimens recently brought from Norway by Mr. C. Pumphrey," by MR. T. H. WALLER, B.A., B.Sc.

November 20th.—On "The Bath Oolite, and the Method of Quarrying," by MR. A. BROWETT.

December 18th.—"Note on a Lithia-bearing Granite," by MR. T. H. WALLER, B.A., B.Sc.

SOCIOLOGICAL SECTION (President, W. R. Hughes, F.L.S.; Secretary, Herbert Stone).—A total of twenty-six meetings

has been held, of which ten were ordinary, fifteen supplementary, and one excursion. At the ordinary meetings the following papers have been read :—

January 24th.—On "Egoism *v.* Altruism and Altruism *v.* Egoism," by MR. A. BROWETT.

February 28th.—On "Trial and Compromise," by MR. W. K. PARKES.

March 27th.—On "Absolute and Relative Ethics," by MR. W. K. PARKES.

April 24th and June 26th.—On Prof. Fiske's "Cosmic Philosophy," by MR. F. J. CULLIS, F.G.S.

October 23rd.—On Herbert Spencer's essay on "The Ethics of Kant," by MR. HERBERT STONE.

November 27th.—On "Modern Railways," by MR. W. P. MARSHALL, M.I.C.E.

The average attendance at these meetings was twelve.

At the supplementary meetings the following papers have been read :—

February 18th.—On the "Genesis of Science," by MR. F. J. CULLIS, F.G.S.

March 1st.—On "The Origin and Function of Music," by PROF. ALLEN.

March 22nd.—On "First Principles," by MR. W. R. HUGHES, F.L.S.

April 5th.—On "Ultimate Scientific Ideas and Ultimate Religious Ideas," by MR. A. BROWETT.

April 19th.—On "The Relativity of all Knowledge," by MR. W. B. GROVE, M.A.

May 3rd.—On "The Reconciliation," by MR. HERBERT STONE.

May 17th.—On "Philosophy Defined," by MRS. BROWETT.

June 7th.—On "Progress : its Law and Cause," by MR. W. R. HUGHES, F.L.S.

June 21st.—On "The Data of Philosophy," by MISS DALTON.

October 4th.—On "The Progress of Evolution," by MR. W. R. HUGHES, F.L.S.

October 18th.—On "Space, Time, Matter, Motion, and Force," by MISS BYETT.

November 4th.—On "The Transformation and Equivalence of Forces," by MR. W. K. PARKES.

November 17th.—On "The Indestructibility of Matter, the Continuity of Motion, and the Persistence of Force," by PROF. POYNTING.

December 6th.—On "The Transformation and Equivalence of Forces," by MISS GOYNE.

December 20th.—On "The Direction of Motion," by MR. A. BROWETT.

The average attendance at these meetings has been thirteen.

On Saturday, July 28th, the members and friends of the section made their eleventh excursion, this being to Evesham to visit Simon de Montfort's country. On this occasion Mr. Howard Pearson read a very interesting paper on Simon de Montfort ; and Mr. Slatter of Evesham, one on the geology of the district.

The section has suffered much loss from the absence of Mr. F. J. Cullis, who resigned the position of secretary on September 25th ; also from the resignation of Dr. Hiepe, who has left the district permanently.

The Library.—The librarian (J. E. Bagnall, A.L.S.) reports that the Library is in a good condition. The issue of books during the past year has been as follows:—Botany, 30; Zoology, 5 ; Entomology, 6 ; Geology, 13 ; Microscopy, 13 ; Philosophy and General, 32 ; total 99, being 82 less than last year. The number of persons borrowing books during the year has been 26, as against 38 in the previous year.

General Property.—The Curators (G. M. Iliff and Herbert Miller) report that the microscopes and apparatus continue in good order, an improvement having been effected during the year in the "Collins' microscopes" by the removal of the side shields of the eye-pieces. A number of microscopic slides of vegetable sections have been presented to the cabinet by Mr. C. J. Watson.

IN SHERWOOD FOREST.

BY OLIVER V. APLIN,

MEMBER OF THE BRITISH ORNITHOLOGISTS' UNION.

The three species of the genus *Phylloscopus*, aptly termed "leaf-warblers," which are annual summer visitors to England, differ very considerably in their distribution in this country. For while the Willow Wren is diffused throughout the length and breadth of the land, becoming only slightly less abundant in the west, and the Chiffchaff is widely spread over all but the northern counties, the range of the Wood Wren is far more restricted, and this species can only be characterised as local in a high degree. In nowise a southern bird, it is indeed reported as abundant in the five counties which form the north of England, while the forest districts and the more wooded parts of the country, as far as the south coast, also afford it a home.

One thing is a *sine quâ non* in the character of a country side, if the presence of the Wood Wren is to be insured, viz., a more or less wide extent of woods ; and, in my experience, those consisting chiefly of oak are preferred. In such

situations I have met with it in Warwickshire and Devonshire, but nowhere in such plenty as in one locality along the banks of the Thames in South Oxfordshire, and in Nottinghamshire in those great woods which now cover a part of the district which was formerly the noted Sherwood Forest. Here under the able tutorage of a resident friend (a well known field-naturalist, who has paid especial attention to this species), I first became well acquainted with the interesting and peculiar habits of these delicate little birds.

The woods are for the most part composed of oak of various ages, interspersed in places with remarkably fine larch and with plantations of Spanish chestnut. Where the timber is of older growth the wood is rather open, and here the ground underfoot is less deeply covered with dead leaves than in the thicker portions, and the bracken and bilberry grow, while little open glades here and there are clothed with heather and bracken. On the edges we have hollies and rowans, and the ground in spring is blue with wild hyacinths.

On entering the wood in the breeding season one soon hears the sibilant song of the male Wood Wren, and presently we catch sight of him flitting about the tops of the leafy oaks, pausing every minute to run through his simple and very remarkable song with shivering wings. Now he utters his call note, *twee twee twee*, as he sidles along a branch, or flutters in the air for a moment to catch a passing gnat or snatch some tiny insect from an oak leaf just out of reach, then he sings again. If it is late enough in spring for the Wood Wren to have eggs, and you notice the male very loth to leave a certain spot, constantly returning to the same tree, you may be pretty sure that somewhere at or near the foot of it his mate is sitting on her nest. Should she come off to feed or be frightened off, you will be instantly apprised of the fact by her deep plaintive single call note, *wee-eep*, totally distinct from that of the male. The Wood Wren is a late breeder, not having eggs in these woods in the first days of June, 1887, nor even nesting there at the end of May in the following year, though two or three days later I saw a nest containing seven eggs in South Oxon. In Sherwood the nest is placed upon the ground, among the dead leaves and bracken; in younger woods, where the trenching remains, it is often on the side of one of the little banks thus formed. It is wonderfully well hidden, and the hen bird seems well aware of this, for unless you happen to walk right on to the nest she will not fly off until you have passed it. The finding of Wood Wrens' nests in these woods is, therefore, rather an art, and the following plan for doing so was detailed to me.

You have first to find a cock bird in song, and mark the tree to which he continually returns after little excursions in search of food. Somewhere under or near that tree the hen is sitting on her nest; your business is to frighten her off. My host uses a pocket-handkerchief tied to the end of a long stick, with which, by waving it to and fro about a foot from the ground, he can beat some extent of ground. Most probably the hen will slip off unobserved, but you will know at once when she has left her eggs, as her call note will be heard, and the cock will cease singing and go to her. The nest-hunter must then hide behind a tree-trunk, and keeping his eye on the hen bird, patiently watch until she goes on to the nest again. After flitting about for a time, she descends from the tree tops, and presently drops suddenly down to the nest and disappears. Haply you have marked her in, but very often she slips on unobserved, and you only become aware of the fact from hearing the cock resume his song; in this case the whole process has to be gone over again. In South Oxon, where the woods are of a different nature, the nests are more easily found. A nest taken in Harlow Wood, in my possession, is composed of large grasses, bracken, dead leaves, and a little moss, and is lined with finer grasses, not hair, as stated by some authors, a fact first noticed, I believe, by my cicerone.

The Nightjar is pretty common in these woods, frequenting the little open glades, especially on sheltered slopes, where among the heather and bracken it finds a secure resting-place during the day. In such situations the hen deposits her grey-marbled eggs on the ground. When flushed in the daytime they flit away with their peculiar glancing, buoyant flight, but seldom go far, and generally alight again on the ground. But occasionally they will perch on the branch of a tree, sitting, as is their invariable custom, lengthways upon it, when they are very inconspicuous. The way these long-winged birds will twist in and out through the branches of a low oak, when one happens to be in their line of flight, is really wonderful. Large white spots on the outer tail feathers of the male, very conspicuous in flight, serve to distinguish the sexes at first glance. The best view I ever had of a Nightjar on the ground was here, when an individual, which we flushed among some young timber, settled on an old green ant-hill at the foot of an oak only a few yards from me. Those great wood-ants, by the way, are most formidable creatures, capable of inflicting a sharp bite. They are very numerous in parts of this stretch of wood, and the keepers search eagerly for their nests in early summer for the sake of the ants' pupæ cocoons,

or "eggs," so essential to the health of young Pheasants. There must be something very attractive to Nightjars in Thieve's Wood, for the only example of the Egyptian Nightjar ever known in Great Britain was shot here.

Not very many species of birds will be found in the deeper parts of the woods (this particular stretch consisting of two, separated only by a road, covers about 850 acres), but on the outskirts Tree Pipits like to breed, and are common, and some of our woodland warblers and finches, together with members of the thrush and tit families, will be noticed. In cold spring weather, however, it is pleasant to penetrate far into the thick warm wood, where, save for the waving of the tree-tops, you forget the searching east wind outside. The laughing cry of the Green Woodpecker is often heard, and the naturalist's attention may sometimes be attracted by a little heap of chips at the foot of a tree, which leads to the discovery of a freshly-hewn hole in the trunk. The Greater Spotted Woodpecker is also found sparingly, but I have only once met with it. The old woodpecker holes are a godsend to the ubiquitous Starlings, which occupy most of them to the exclusion of other birds, the noisy chattering of their young broods being a common sound as one strolls through the forest in late spring. Perhaps it is this usurpation of available holes which induces the Redstart to place its nest in this locality (where natural nesting sites should be plentiful) among dead leaves and bracken on the ground. I have examined a nest in this unusual position, and others have been known. The Woodpigeon or Ring-Dove is naturally plentiful, and a few pairs of Jays may be noticed, though the remains of far more adorn the keeper's gallows, while in winter that northern freebooter, the Hooded Crow, is a frequent and numerous visitor.

The Woodcock, of which a few pairs occasionally remain to breed here, deposits its eggs in a rudely-formed nest among the dead oak leaves, which match in tint the bird's russet plumage—a beautiful illustration of that protective colouring to which so many ground-breeding birds trust for the safety of their eggs and newly-hatched young. In some parts large holly trees grow freely. When I first knew the woods, some five years ago, these were green and flourishing, but most of them have been killed since then by the rabbits, which have increased, gnawing the bark during the late severe winters. Under the spreading branches of glossy leaves the Woodcocks found in winter a warm and sufficiently darksome retreat in the daytime. Notoriously eccentric in its choice of winter quarters, the Woodcock visits Thieve's Wood in

considerable numbers (while these notes were in progress I heard of five forming part of the bag made in the middle beat one November day), but in Harlow very few are ever found, albeit only a road separates the two woods. The hollies which still survive, are utilised by another and very different bird, which builds its nest in them, viz., the Blackcap, whose clear sweet notes may often be heard there in May. At the extremities of the branches, among the dark green prickly leaves, it forms its nest, which doubtless often escapes observation from its position. It is easiest to see the nests by creeping under the tree and taking observations from inside. I have seen the Blackcap's nest in a similar situation in Berkshire, and in one such found a clutch of the beautiful salmon-pink variety of the eggs.

The Lesser Redpole, best known as a winter visitor to the south, is not uncommon on the outskirts of the woods, where it forms the beautiful, warm, cup-shaped nest, destined to hold that clutch of eggs so entirely *Fringilline* in character, and yet so small—something like miniature Linnets' but with a bluer ground colour. The naturalist who has watched them in winter restlessly flitting about the heads of the alders along the banks of the half-frozen streams, or clinging to the slender leafless twigs of the birches in copse and shrubbery, gladly renews his acquaintance with these tiny linnets in their summer haunts. The birches which, with the alders, furnished their favourite food in winter, still possess attractions for them, and on some branchlet gently swayed by the breeze, amid the delicate waving green leaves of this most elegant tree, the cock Redpole loves to sit and sing his sweet twittering strain. Sometimes, too, a pair of Red-legged Partridges are detected as they run among the dead bracken and heather in the thin open wood. These birds have become numerous of late years, and seem to prefer the edges of woods, rough ground generally, and the open, heathery, forest land, to the cultivated fields. But they certainly have not interfered with the increase of the Grey Partridge. The cultivated land, with its light sandy soil and extensive turnip and seed-grass fields, which lies around and encroaches upon the remnants of the once great Sherwood, can almost vie with the best parts of Norfolk in the production of "birds." Late in May, when leaning at evening over the gate of one of the great seed-fields, which, in cold springs, are bitten rather bare by the sheep, I have counted six or seven breeding pairs feeding out on the short turf, within a short distance of one another; and in walking across my friend's paddock we have put up as many as half-a-dozen pairs.

(To be continued.)

MICRO-CHEMICAL METHODS FOR THE EXAMINATION OF MINERALS.*

BY MR. T. H. WALLER, B.A., B.SC.

The difficulties of the geologist who undertakes the examination of rocks in thin slices by means of the microscope are so great, and the determinations at which it is possible for him to arrive are so frequently based on evidence which it is a matter of extreme difficulty to present to others whom he may wish to convince, that he is sure to hail with delight any fairly simple and accurate means of settling by actual analysis, even though it may be on a very minute scale, the composition, and hence the nature, of the mineral components of any rock he may have under his observation. Optical methods of research have of late years made extraordinary advances. The apparatus for observing the effects of a minute crystal section on converging polarised light, and hence of coming to a conclusion as to the position of the optic axes of the crystal, whether the crystal is uniaxial or biaxial, and whether the double refraction is positive or negative, enables us in many cases to discriminate between minerals which present a very similar aspect when reduced to thin slices—*e.g.*, quartz and clear felspar. That purely optical methods do not, however, always lead different observers to the same results, may be seen from the correspondence as to the nature of a certain constituent of some of the serpentines of the Lizard district which appeared in the "Geological Magazine" last year. And yet the difficulties in the way of an analysis are considerable. Of course where the crystals are of such a size as to be separable by careful breaking out, and are in sufficient quantity, a quantitative analysis by the ordinary methods of the laboratory is possible, and is the best possible procedure. Where the "grain" of the rock is moderate, it is still possible, when the mass has been crushed to a tolerably even fineness, to separate the constituents by means of some of the heavy salt solutions which are prepared for the purpose, such as the double iodide of mercury and barium, or of mercury and potassium, and make a chemical examination of the different parts. By this means most valuable results are obtained, and it is not necessary to do more than refer to almost any thorough examination of a rock published in the geological journals to show the importance of the procedure.

* Read before the Birmingham Natural History and Microscopical Society, October 18, 1887.

What is, however, perhaps even more to be desired by the working petrologist is the power to decide in a short time and without a quantitative analysis, the material for which can often be obtained only by a series of very laborious and tedious operations, and, indeed, is often quite out of his power to obtain at all, as to the nature of a particular mineral grain which he may come across in the course of an investigation. Any analysis in this case must naturally be qualitative rather than quantitative, and must also of necessity be on a very minute scale, and it is with a short account of a few special methods devised for this purpose that I have the honour of occupying your attention this evening.

The first method I have to mention has specially for its object the discrimination of the various members of the felspar group. It was devised by Dr. J. Szabó, of the University of Buda Pesth, and depends on observations of the fusibility of grains of the substance in certain definite positions in the flame of a Bunsen burner, and on the flame colouration produced.

In order that observations may be comparable, exact attention must be paid to the dimensions of the burner, the height and character of the flame, the thickness of the platinum wire which is used as a support, the position of the assay in the flame, and the duration of the experiment. The experiments are three:—Firstly, 5mm. above the burner in the outer zone of the flame; secondly, 5mm. above the chimney shield; and, thirdly, in the same position as the last, but with the addition of a small quantity of gypsum to act as a flux, and render more of the alkalis volatile. During each experiment the flame is observed. The intensity of the yellow, due to soda, is estimated according to the scale given, and then the soda flame is eliminated by means of observing through glass coloured a deep blue by cobalt, and the violet colour, due to potash, similarly valued. The experiment lasts 1min. in the first two cases, 2min. when the gypsum has been added. At the end of the minute the assay is removed from the flame and examined through a lens for evidences of fusion. There will, in some cases, be only a very slight rounding of the sharp corners, at others a more or less complete fusion. The appearance of the grain is also observed with regard to the bubbles which form in it either in the interior or on the surface, and also for the condition of the surface, whether glassy or enamel-like. From the sum of these observations it is possible to arrive at very accurate results, but for the particulars I must refer to the original memoir. Anyone, however, may gain a very considerable

mastery of the method by comparing known felspars placed simultaneously in the flame, on opposite sides of it, and observed together. In this way the distinction of anorthite from labradorite becomes quite easy, and the soda percentage of an orthoclase may be estimated with considerable approach to accuracy.

The second method I have to speak of is of somewhat limited application in certain ways, although it is applicable to other minerals than the felspars.

It is that adopted by Dr. E. Bořický, of Prague, who explains that he could not use Szabó's method because there was no gas supply at his disposal. He decomposes the mineral with a dilute solution of fluosilicic acid on a glass slide, which has been evenly covered with a coating of hard Canada balsam, and after allowing 24 hours for the decomposition, allows the drop of reagent to evaporate as far as it will, in a dry, slightly warm place, and examines the forms of the fluosilicates which are left. Some of these are highly characteristic—the potash salt crystallises in brilliant octohedra, variously modified; while the soda compound, which is somewhat more soluble, and is therefore not quite so readily crystallised, separates in short, stout, hexagonal prisms. Unfortunately the determination of lime is not so certain, the forms due to it being less definite and liable to modification in presence of soda. The fluosilicates of protoxide of iron and of magnesia have the same crystalline form, and are both quite soluble in water, so that they are not very easily obtained, and can only be distinguished from each other by exposing them to the action of either the vapour of sulphide of ammonium, which blackens the iron salt, or of chlorine, which reddens it.

On the whole, I think this method may be said to be superseded by the processes to which we now come. Details of the tests differ, but the principle is—decomposition of the mineral by either hydrochloric, sulphuric or hydrofluoric acid, according to the necessities of the case, and the subsequent examination, mostly by precipitation methods, of the solution thus obtained.

The decomposition may be effected directly on a section picked out by the microscope and isolated by means of a hole of suitable size, made either in a cover glass or where hydrofluoric acid is to be used in a piece of platinum foil. This is cemented on to the section with balsam, the hole must be cleared of balsam, and thoroughly cleaned with spirits of wine, and the mineral grain thus exposed can be subjected to the action of the acid, which should be led into the

hole from one side by means of a fine wire, so as to avoid the formation of air bubbles. The preparation must be gently heated, a tin box full of hot water, with a lid on which to lay the glasses, answers well; and when the first quantity has evaporated, a second, and, if necessary, a third and fourth drop may be added. Finally the acid is replaced by water, and the soluble salts removed by a very fine pipette made of a piece of narrow glass tube drawn out to a very fine point. This solution is then distributed into separate drops on a glass slide, and the further examination proceeded with.

If a minute grain can be separated, the decomposition of it may be effected in a little platinum spoon, such as is used in blowpipe analysis. The action of the acid is much facilitated by the fine grinding of the specimen to be examined. This should be effected either on a polished steel anvil with a polished steel pestle, using a ring of glass to prevent the dispersion of the powder, or in an agate mortar. If porcelain were used the abrasion of the mortar might occasionally introduce sufficient impurity to falsify the results of the subsequent tests.

The hydrofluoric acid may be replaced by fluoride of ammonium, which can now be procured in a state of very great purity. In this case, however, the residue of salts must be heated to redness, in order to be sure of getting rid of all trace of ammonia, as this, by the similarity of its reactions, might easily be taken for potash. The action also is said to be less energetic than that of hydrofluoric acid, so that probably the acid is the better of the two, although being solid the salt is by far the more convenient. In any case when the fluoride compounds are dried up, or nearly so, a drop of sulphuric acid, diluted somewhat with water, must be added, and the whole again gently heated. If the sulphuric acid has been added in sufficient quantity the excess will be driven off in a dense cloud, and if this does not take place another drop must be added, and the evaporation repeated. It is advisable not quite to dry up the mass of salts. as when quite dry they dissolve in the water which is next added with much greater difficulty.

If the operations have been successfully performed, we shall have a solution of all the bases of the mineral in combination with sulphuric acid, and, as before stated, this must be distributed in drops on to glass slips by means of a finely drawn out glass tube.

If one of these drops is allowed slowly to evaporate, and is observed from time to time with a power of about 100, the presence of *Lime* will be shown by the formation in the drop,

and especially at the edges of the very characteristic needles or blades of gypsum, showing the proper angles of the clinopinacoid of the crystals, and occasionally the arrow-head twin which is so frequent among the larger natural crystals. Behrens speaks of this test as of extreme delicacy, and says that it is capable of showing $\frac{1}{2000}$ mgr. of lime. To another drop add at one edge a fragment of bisulphate of potash, unless you feel inclined to pay for the corresponding salt of cæsium, which, however, is decidedly more delicate as a test. In presence of alumina the octohedra of potash (or cæsia) alum will begin to appear almost at once, and are quite unmistakeable. As the potash alum only contains about 10 per cent. of alumina, and the cæsia salt only about 9 (the latter, moreover, is very much less soluble in water), the delicacy of the reaction is considerable. In cases where potash and alumina are both present in the mineral under examination, as *e.g.*, in the case of an orthoclase, or a rock containing orthoclase, the presence of both bases may be shown by the crystallising out of the alum along with the needles of gypsum.

At a distance of about $\frac{1}{5}$ of an inch from another of the drops place a drop of a solution of chloride of platinum, and allow the drops to run together and gradually mix. The presence of *Potash* will be shown by the almost immediate appearance of the double chloride of platinum and potassium in orange yellow octohedra, variously modified about the angles. Where only minute proportions of potash are present the distinguishing crystals may only appear on the partial evaporation of the drop. If the bases have been dissolved as chlorides of the various metals, the reaction for potash is more rapid, but the crystals are less perfectly shaped.

To test for *Soda* we may use either the acetate of uranium, as suggested by Streng, or sulphate of cerium, as preferred by Behrens. The former reagent must be added to the dried residue of a drop of the solution of the bases slightly evaporated, and observed on cooling. In the presence of soda distinct yellow tetrahedra of the double acetate of sodium and uranium separate. They contain less than 6 per cent. of soda, and therefore show a very minute quantity of this base, but the test cannot be applied in the presence of free sulphuric acid, even of a mere trace, and is also liable to be obscured by the formation of crystals of the acetate of uranium, or of a basic acetate. A little practice, however, will enable very good results to be obtained.

In solutions of the sulphates the addition of a concentrated solution of cerous sulphate (the yellow *ceric* sulphate is of no

use) produces the precipitation of the double sulphate of cerium and sodium, in the form of a cloud of minute granular masses, without any distinct crystalline form. Potash produces a similar double sulphate, but it separates somewhat later and in much larger granules. Behrens describes them as somewhat similar in appearance to the starch grains of potato. The reaction is obviously the usual one adopted for the separation of the cerium metals, and as the other bases which usually accompany ceria form similar compounds with the sulphates of soda and potash, though not so readily, the purity of the cerous sulphate is not imperative—an important fact, as the salt which is to be obtained of the dealers in chemicals mostly contains a quantity of the allied bases, the purification from which is a difficult matter.

For *Magnesia* we test by adding a drop of dilute hydrochloric acid, then dilute ammonia, and then connecting with the drop by a narrow channel another drop of water in which has been placed a small lump of microcosmic salt. The distance of the drops should be about $\frac{1}{5}$ of an inch, the reason being that the slow mixing of the solutions is essential to the formation of the characteristic crystals, different at the two ends, of the phosphate of magnesia and ammonia. In the presence of iron and alumina we must wait after the addition of ammonia till these bases are precipitated, and they then do not interfere.

Reciprocally, an ammoniacal solution of magnesia may be used to test for *Phosphoric Acid*. As, however, we have frequently to test for this acid when occurring in apatite crystals, which are so enveloped in other minerals that the products of decomposition and solution are mixed together, recourse is frequently had to a solution of molybdate of ammonia in nitric acid. The mineral should be attacked with nitric acid, and the solution mixed on a glass slip with the molybdic solution. The presence of phosphoric acid is shown by yellow octohedra and rhombic dodecahedra of the ammonic phosphomolybdate.

Our tests of *Lithia* are not very satisfactory, but carbonate of potash is said to give fair results. On the other hand very small proportions of lithia are easily distinguished by means of the spectroscope — even one of the small direct vision spectroscopes which are made for the pocket. A fragment of the mineral heated with gypsum in the zone of fusion of the Bunsen burner shows at once the intense red line, lying between the principal lines, due to soda and potash. The carmine colour, which pure lithia salts impart to the flame, is completely masked by a very minute quantity of soda, but

may be recognised on examining the flame through a solution of indigo instead of through a blue glass, as when testing for potash. The glass cuts off the lithia flame as well as the soda flame, but through the thinner parts of the indigo solution, which completely stop the yellow light due to soda, the lithia flame is still visible, but gradually disappears before the thicker parts are reached.

With the help of a pocket spectroscope I have detected lithia in the great majority of micas from granites which I have examined. not only in lepidolites, but even in dark micas which would, no doubt, come under the division of the biotites.

It is obvious that before coming to any conclusions on the constitution of a mineral by these micro-chemical methods. the reagents used must be most carefully tried by blank experiments, so that we may be quite sure that there is no trace present of the base the presence of which we wish to determine. For instance acetate of uranium, as usually bought, must be recrystallised, and probably twice over, before it ceases to show on evaporation the yellow tetrahedra due to the presence of soda. Chloride of platinum must be carefully examined as to the absence of potash (or ammonia), which would make itself unpleasantly manifest on slight evaporation. The best method for purifying this reagent is to dissolve the solid salt in as neutral and dry a state as possible in absolute alcohol, filtering off any small quantity of undissolved double salts and evaporating the filtrate to get rid of the alcohol.

In the next place it is of course essential for the beginner to proceed methodically—testing, first, known salts of the various bases, then known minerals. Fragments of the different felspars, augites, hornblendes, micas, &c., of which the composition is at least approximately known, should be first examined, and the results obtained compared with those of the ordinary analysis. The student is then in a position to proceed to the examination and determination of minerals in a rock; first of all, those which he can detach as being more easily manipulated; finally, as he acquires practice with small quantities of material, attacking the cases where only a thin section is available and the grain has to be isolated by means of a perforated screen as above described.

In conclusion, I may refer to my authorities:—

Szabó, "Ueber eine neue Methode die Feldspathe auch in Gesteinen zu bestimmen." Buda Pest, 1876.

Bořický, "Elemente einer neuen chemisch-microscopischen Mineral-und Gesteinsanalyse." Prag., 1877.

Streng, Neues Jahrbuch für Mineralogie und Geologie. 1885, I., p. 21.

Behrens, "Chemical News." 1886, Oct. 15 to Dec. 24.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from Vol. XI., page 307.)

Midland Counties Herald, August 5th, 1838.

"Remarkable plants observed growing spontaneously in the neighbourhood of Birmingham by Wm. Ick. Curator of the Birmingham Philosophical Institution." Worcester plants only included. The previous records of Dr. Ick and Miss Beilby omitted.

Aconitum Napellus. Meadow at Northfield.

* **Turritis glabra.** Near Stourbridge.

Erysimum cheiranthoides. Caledonia, near Stourbridge.

Lepidium hirtum (*L. Smithii*). Near Stourbridge.

* **Thlaspi arvense.** Near Stourbridge.

Sisymbrium Sophia. Near Stourbridge.

* **Polygala vulgaris** (*P. depressa ?*) Moseley Bog.

* **Stellaria uliginosa.** Stony Lane, Moseley.

* **Epilobium tetragonum** (*E. obscurum ?*) Meadows beyond Vaughton's Hole.

* **Montia fontana.** Stony Lane, near the top.

* **Sanicula europæa.** Moseley Bog.

* **Adoxa Moschatellina.** Edgbaston Lane, near Moseley Hall.

* **Viburnum Opulus.** Moseley Bogs.

* **Valeriana officinalis var.** β. Stirchley Street, near King's Norton.

* **Dipsacus pilosus.** Meadow near the field path from the back of the Pebble Mill to Moseley.

* **Solidago Virg-aurea.** Halesowen Road.

* **Eupatorium cannabinum.** Edgbaston Lane, near Avern's Mill.

* **Pulicaria dysenterica.** Yardley, near the bridge.

* **Campanula latifolia.** Yardley, on the bank of the stream a little below the bridge.

* **Digitalis purpurea.** Banks around Moseley Common.

* **Narcissus Pseudo-narcissus.** Meadow near the National School, Moseley.

Juncus squarrosus. Moseley Bog.

* **J. uliginosus** and var. *subverticillatus*. Moseley Bog.

Triglochin palustre. Moseley Bog.

* **Eleocharis palustris.** Moseley Common.

* **Scirpus cæspitosus.** Billesley Common.

* **Carex remota.** Stony Lane, Moseley.
* **C. ovalis.** Near Stourbridge.
* **C. riparia.** Side of the Rea beyond Vaughton's Hole.
* **Melica uniflora.** Stony Lane, Moseley.
* **Nardus stricta.** Moseley Common.

Equisetum sylvaticum. Moseley Bog.

E. hyemale. Moseley Bog.

List of some of the rarer plants observed in the neighbourhood of Birmingham by Samuel Freeman, 11, Sun Street West, Birmingham. October, 1841.

"PHYTOLOGIST," JULY, 1842, 1ST SERIES, VOL. I., p. 261.

Worcester plants only included. and previous records by Dr. Ick and Miss Beilby omitted, except in the case of *Osmunda regalis.*

* **Rhamnus catharticus.** Yardley Bridge.
* **Epilobium palustre.** Moseley.
* **Ribes nigrum.** Yardley Bridge.
* **Myosotis cæspitosa.** Moseley.
* **Carex ampullacea.** Moseley.
* **Aira præcox.** Moseley Common.
* **Danthonia decumbens.** Moseley Common.
* **Osmunda regalis.** Moseley Common.

The "Phytologist" for March, 1843, Vol. I., pp. 508.514, contains lists of the Ferns and Fern Allies from the counties of Stafford, Warwick, and Worcester, contributed by the Editor, the late Edward Newman. The Worcester list includes, *inter alia*, the following records :—

* **Cystopteris fragilis.** In fissures of the Oolitic rock on the summit of Bredon Hill, on the side of the precipice; near Bromsgrove Lickey; E. Lees.
* **Polystichum angulare.** Near Clifton-on-Teme. T. Westcombe.
* **Lastrea spinulosa.** I used to find it in some of the bogs on Moseley Common, which I believe have since been drained. G. Luxford.
* **Ceterach officinarum.** Very sparingly on walls at Great Malvern, but not on the rocks of the hills, and I should say this fern is not at home in Worcestershire; E. Lees. Badsey, near Evesham ; T. Westcombe.
* **Osmunda regalis.** Moseley Common ; E. Lees, W. Southall, junr., D. Cameron, G. Luxford, W. G. Perry.

Lycopodium clavatum. On a Sandstone cliff by the Severn, at Winterdyne, near Bewdley, T. Robinson, from whom I have a specimen, E. Lees; bog on Hartlebury Common, R. J. N. Streeten; Moseley Common, W. Southall, junr.

Equisetum fluviatile. *(Var. of E. limosum.)* Plentiful in boggy woods near Worcester, Great and Little Malvern; indeed generally, E. Lees; near Worcester, T. Westcombe.

Mr. Newman's well-known "History of British Ferns," of which the first edition was published in 1840, and the second in 1844, contains no new Worcester records.

The Rev. W. L. Baynon, Rector of Seal, Surrey, who resided at Bewdley, in or about the year 1835, was a botanical correspondent of my friend, the Rev. J. H. Thompson, the present Incumbent of Cradley. He informed Mr. Thompson that, at that date, *Drosera rotundifolia*, *Erodium maritimum*, and *Radiola millegrana* were growing at Pedmore Common, near Stourbridge. They are not now to be found there. The localities of these, and other rare plants in the neighbourhood of Kidderminster and Bewdley, were communicated by Mr. Baynon to *The Ten Town's Messenger*, a newspaper published at Kidderminster at that time. I have not succeeded in procuring the paper containing Mr. Baynon's communication, and am therefore unable to incorporate his records in the present history.

(To be continued.)

Review.

Catalogue of Canadian Plants. PART IV., *Endogens.* 8vo. By JOHN MACOUN, M.A., F.L.S., F.R.S.C.

THE first volume of this valuable work on the Canadian Flora was favourably reviewed in the "Midland Naturalist," Vol. X., p. 102, 1887. The excellent features of that volume are fully sustained in Part IV., which is the first instalment of Volume II.

In this part the Endogens are dealt with, and the enriched experience gained by the investigation of new districts is seen in the more copious notes on the distribution of each plant.

"Since the publication of Part III., extensive collections have been made by James M. Macoun on the shores and islands of James Bay. Dr. G. M. Dawson has made valuable and interesting notes and collections in that part of the North-West Territories bordering on Alaska. The writer (Prof. John Macoun) spent five months collecting on Vancouver Island, and gathered much valuable information regarding its flora. That part of this additional information which is applicable to the Endogens is included in the present issue."

As in the former volume, the editor has not relied exclusively upon his own individual judgment in determining and verifying critical or new species. The assistance is acknowledged of several of our best known experts, such as Dr. Sereno Watson, more especially in the Liliaceæ and Juncaceæ; Mr. Arthur Bennett, F.L.S., of Croydon, for assistance in the Naiadaceæ and Carices. The Rev. Thomas Morong, Mass.; W. H. Beeby, A.L.S.; and the veteran botanist, Dr. Vasey, have also rendered valuable assistance.

To the student interested in geographical botany, this work will present many features of great value, and will enable him more fully to appreciate the hypothesis, with regard to the spread of plants, so ably enunciated by Sir J. D. Hooker, in his classical "Outlines of the Distribution of Arctic Plants," published in "The Transactions of the Linnean Society, Vol. XXIII., page 251.

The number of Endogens recorded as occuring in the Dominion is 747 species, and of these 170 are natives also of Great Britain or Ireland; many of these being our rarest northern and alpine plants, but some of them are the more familar plants of our woods, pastures, and waysides, so that the British botanist who visits Canada will, amidst much that is strange, now and again have his eyes gladdened by the presence of an old and familiar friend. The total number of Phanerogams recorded from the Dominion of Canada is 2,955, of these 2,208 are Exogens, and 747 Endogens.

The volume throughout bears evidences of careful work, close investigation, and unremitting industry; and the greatest care appears to have been used in discriminating the alien and casual plants from those that are truly native.

Two more parts will bring the work to a close, and as these will contain the Cryptogams their appearance will be looked forward to with much interest. Already over 2,000 species of named Cryptogams are now in the herbarium, and Prof. Macoun anticipates that this number will be increased to at least 2,500 species before the issue of the next two parts. Part V. will contain the ferns and their allies, with the mosses and liverworts, and it is intended in Part VI. to catalogue the lichens, fungi, and seaweeds.

The work is printed in bold type and on good paper, and when completed will form one of the most valuable and interesting of the American floras.

J. E. Bagnall.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Supplementary Meeting, Dec. 20. Mr. W. R. Hughes in the chair; twelve members present. Mr. Hughes gave a sketch of the history of the section. Mr. Browett gave his exposition of the ninth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Direction of Motion." An interesting and animated discussion followed. —Biological Section, January 8th. Present fifty members and friends. Mr. E. Catchpool, B.Sc., of Sheffield, read a remarkable paper on the "Flight of Birds and Insects," an abstract of which will appear in the next number. The paper was illustrated by excellent but simple models, by which each point of Mr. Catchpool's argument was demonstrated in turn.—Sociological Section, Supplementary Meeting, January 10th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Stone exhibited a series of tail feathers from the common peacock, showing a gradual transition from the perfectly-formed, characteristic eye, to an almost bare shaft having only a few laminæ remaining, and these entirely confined to one side. Mrs. Browett gave her exposition of the tenth chapter of Herbert Spencer's "First Principles," entitled, "The Rhythm of Motion." Eleven members present.—Sociological Section, Jan. 22nd. Four new members were elected. Mr. E. H. Wagstaff exhibited the head of *Attus aurora*, a very rare spider, from Penang, showing the

eight brilliant eyes. Mr. Cuming Walters then read his paper on "Tennyson's Country." He said that his object had been to examine the localities amidst which the poet had been born, and where he had laid the scenes of his earlier poems. Lord Tennyson was above all an English and an English-loving poet. The tone of his poems was essentially that of Lincolnshire, sombre in hue, but possessing quiet beauties of its own. The best time to see Lincolnshire was in the autumn, which was also the poet's season. The writer described Tennyson's birth-place at Somersby, and quoted references to it from "In Memoriam;" also the farmhouse close by, called a "grange" in Lincolnshire, which was inhabited by the original of the "Northern Farmer," and was itself Mariana's "Moated Grange;" and Holywell Glen, a gloomy hollow which was the scene of the "Lover's Tale," and doubtless suggested to the poet the dismal story of "Maud." He also spoke of the Lincolnshire characters who are pourtrayed by Tennyson:—his mother, described in the "Princess," the originals of Lady Clara Vere de Vere, Sir Harry Vane, and others. Tennyson's sea-pictures—even those of the "Lotos Eaters"—are mainly such as can be seen on the Lincolnshire and Norfolk coasts; his wild flowers and his garden flowers are those of Lincolnshire, and the influence of the county can be traced through all his early work. Mr. W. R. Hughes pointed out the Sociological importance of the subject, which was a particularly striking instance of the influence of the environment upon the organism, and thus Mr. Walters had perhaps been talking Evolution without knowing it.—SOCIOLOGICAL SECTION, SUPPLEMENTARY MEETING, Jan. 24th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Hughes announced that he had received a post card from Mr. Spencer in reply to a letter in reference to Prof. Poynting's, in which he said that he had not read the article but could add nothing further to his reply to Moulton, published in the third volume of Essays. Also, that he had received a few copies of the "Modern Science Essayist," the organ of the Brooklyn Ethical Association, and suggested that some marks of sympathy should be sent to them from the Section. Mr. Stone gave his exposition of the eleventh chapter of Herbert Spencer's "First Principles," entitled "Recapitulation, Criticism, and Recommencement," in the absence of Mr. Grove, who was unable to attend. After which, he read extracts from Mr. Spencer's "Replies to Criticism," dealing with the points disputed by Prof. Poynting.—GENERAL MEETING, Jan. 29th. The President, Mr. W. B. Grove, M.A., occupied the chair, and there was a large attendance of members. Mr. W. P. Marshall, M.I.C.E., gave an interesting account of the masses of rock that fell recently at Niagara Falls, and exhibited a sketch showing the outline of the "Horseshoe" Falls previous to the fall of rocks and also of their present form. Mr. J. E. Bagnall, A.L.S., exhibited for Miss Gingell (who was present) *Hypnum Sommerfeldtii*, *H. abbreviatum*, *H. triquetrum* in fruit, *H. brevirostre* in fruit, and other rare mosses from Dursley, Gloucestershire. Mr. C. Pumphrey and Mr. C. J. Watson exhibited by the aid of the oxy-hydrogen lantern a large number of photographic views of objects and places of interest in Switzerland, Italy, the Channel Islands, Weymouth, Bath, and of the recent beautiful hoar frost on leaves and trees in this district, which were much appreciated by the meeting, and a hearty vote of thanks was passed to them.—ANNUAL MEETING, February 5th. Mr. W. B. Grove (president) in the chair. There were also present Messrs. W. P. Marshall and W. H. Wilkinson (secretaries), J. Rabone (treasurer), J. Levick, R. W. Chase, J. F. Goode, Herbert Stone, W. R. Hughes, J. E. Bagnall, J. Edmonds, J. Udall, Kineton

Parkes, C. J. Wainwright, G. Hadley, C. Pumphrey, and J. Pumphrey. The annual report (which is printed in full at page 49) and the financial statement having been read, Mr. W. K. Parkes proposed the adoption of the report and financial statement.—Mr. W. A. Parker seconded the motion, which was carried unanimously.—On the proposition of Mr. Hughes, seconded by Mr. Levick, a hearty vote of thanks was accorded to the president for his services to the society during the past year. Votes of thanks were also passed to the editors of the Birmingham press for inserting reports of meetings, and to the officers of the society.—Mr. Grove was re-elected president for the year; Mr. Rabone was re-appointed treasurer, and Messrs. Wilkinson and Marshall general secretaries.—BIOLOGICAL SECTION, February 12th. Mr. R. W. Chase in the chair, among those present being Messrs. Bagnall, Grove, Hughes, Levick, Marshall, Pumphrey, and Wilkinson. Mr. Charles Pumphrey was elected president and Mr. Thomas E. Bolton as secretary of the section for the present year. Mr. Bagnall exhibited, for Miss Gingell, *Hypnum molluscum* and *Anomodon viticulosum*, from Dursley; also, for Miss Taunton, *Aristolochia bœtica* and an *Arum* from Spain. Prof. T. W. Bridge, M.A., then gave a valuable and interesting paper on "The Structure and Function of the Air-bladder in Certain Fishes," illustrating it by means of many diagrams and skeletons of various fishes. A discussion followed in which Messrs. Pumphrey, Chase, Hughes, and Grove took part.—SOCIOLOGICAL SECTION, SUPPLEMENTARY MEETING, Feb. 14th, in the Society's room. Mr. W. R. Hughes, F.L.S., in the chair. The minutes of last meeting being read and confirmed, the President read a letter from Mr. Spencer calling attention to an essay by a German author, Dr. Karl Kinderman, on the "Entwickelungslehre of H. Spencer;" the first sign of recognition of the Synthetic Philosophy in the land of Kant. Also, a letter from M. Grosclande, of Paris, announcing his failure to keep the Parisian Sociological Society afloat, attributing his lack of success to the want of thinking persons, and to the unsettled political condition of the country. A translation of the letter was entered on the minutes. The President also announced the receipt of the Second Part of the "Modern Essayist," from the Brooklyn Ethical Association. Mr. Kineton Parkes read his paper on "Evolution and Dissolution," being an exposition of chapter twelve of Herbert Spencer's "First Principles." The subject, which was ably treated, was afterwards discussed.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—December 17th. Mr. Deakin exhibited *Pandora inæquivalvis*, a marine shell from Bournemouth. Mr. Cracroft described a new method of making drawings of objects to be used at soirées, etc., by Dr. Hudson. The drawing is made on tissue paper and pasted over a circular hole in brown paper. A series of these is fastened in a frame and a light placed behind, when a good effect is produced. A drawing made and mounted in the manner described was handed round.—December 31. Mr. J. Corbet showed a collection of ammonites and other fossils from the Inferior Oolite of Cheltenham; under the microscope, Mr. J. Collins, leaf of *Niphobolus lingua*; Mr. J. W. Neville, anthers and pollen grains of the Japanese hibiscus.—January 7th. Mr. J. W. Neville exhibited the skin of a large Australian snake; Mr. J. Corbet, a small collection of plants from the bush of South Africa.—January 14th. Mr. J. W. Neville showed specimens of ammonites, whole and in section, from Whitby; Mr. J. Betteridge,

male and female specimens of Pallas' sand grouse, *Syrrhaptes paradoxus*, shot at Rednal on December 29th; Mr. J. Madison, fossil impressions of leaves from Bournemouth and Alum Bay, Isle of Wight; Mr. J. Corbet, a large collection of fossils from the Leckhampton Hills; Mr. Moore, a series of sections of fossil woods under the microscope.—January 21st. A general exhibition to which the public were invited. There was a large attendance, and the following exhibits were made by the members:—A number of lantern slides of photo-micrographs of insects and other objects, by Mr. J. Edmonds; photo-micrographs of rock sections, by Mr. T. H. Waller; photographs of orchids and other plants, by Mr. C. Pumphrey; and a series of hand-painted slides, illustrative of pond life, by Mr. J. W. Neville; Messrs. J. Betteridge and P. T. Deakin, a collection of British birds, and specimens of Pallas's sand grouse; Mr. Deakin also showed a collection of Wenlock and Lias fossils; Mr. H. Hawkes, a mounted collection of marine algæ, with drawings of their sporangia; Mr. Camm, a collection of eighty specimens of fungi of the orders Myxomycetes and Discomycetes; Mr. J. Madison, cases of English and foreign land and freshwater shells; Mr. Corbet, fossil leaves from Bournemouth; Mr. Barradale, cases of English and Chinese insects; Mr. C. P. Neville, cases of English and foreign butterflies and moths; and Mr. J. Collins, a collection of local plants. Under the microscopes a series of living and other objects were shown, many deserving of special mention. During the evening a short address was given on the aims and objects of Natural History Societies.—January 28th. Mr. J. Betteridge presented to the Society specimens of the following birds prepared for the cabinet:—Carrion crow, wryneck, common snipe, jack snipe, brambling finch, and chaffinch, for which the thanks of the members were given; Mr. H. Hawkes showed furcated feathers of pigeon, also some in which the barbs appeared to be eaten away, and in their place a growth possibly of fungoid origin. Mr. J. A. Grew then read a second paper on "Insect Mimicry." The writer said the paper would show why insect mimicry was resorted to, and why, in some instances, it was not required. The first cause of mimicry was protection, and an insect was justified in using such an artifice; several instances were given of insects adapting their colour to their surroundings. Not only was colour concerned, but shapes were equally important factors. The mimicry of some insects was confined to the larval stage, the imago throwing off all disguises. The writer said insects had not always enjoyed these advantages, but that long ages had been required to develope those features that would best enable them to secure food and avoid being made food of by others; the results of natural selection had been transmitted in an improved degree through long periods of time.—February 4th. Mr. H. Hawkes read a communication from Mr. W. Tylar, in which he presented six dozen micro. slides to the cabinet of the Society. A hearty vote of thanks was passed; Mr. H. Hawkes, exhibited under the microscope the orange scale coccus, *Lecanium hesperidum*, also *Coccus aceris*, and gave a short account of their life-history; Mr. J. Moore, raphides, etc., in bulb of *Narcissus polyanthus*; Mr. J. Collins, *Draparnaldia glomerata*, with some remarks on the mounting of the same.—February 11th. Mr. C. P. Neville gave a lecture on "Aberystwith and how to see it." The lecture described the scenery of the town and surrounding country. It was profusely illustrated by a series of photographic views, taken during a number of visits to the locality, shown by the lime light.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.*

Before entering upon the subject proper of my address this evening, I wish to say a few words upon some topics relating to our Society, and also to seize this second opportunity of performing a duty which I am fully sensible I owe, and which I have already tried partially to discharge. Let me take the second item first, and say that I feel it no less a pleasure than a duty to thank the members, and especially the Council of this Society, for the honourable position of President which they have assigned to me, and which, I know, I could not have adequately fulfilled, unless I had carried with me throughout the year their goodwill and assistance in the work.

When, at the beginning, I looked back upon the long and illustrious line of men of science and naturalists who have in turn occupied the leading place in this Society, I must confess my heart sank within me at the thought that I could do so little to rival the glories of the past. When I read the names of those who have, in years gone by, filled—yes, actually and literally *filled*—this presidential chair, and calculated by the aid of astronomical observations and the Differential Calculus how small a portion of its superficial area I myself was able to conceal, I was irresistibly reminded of that dark saying of old:—"Behold, there were giants in those days."

Think of our old and veteran commander, the one who first led the nascent Society from its cradle, and for three successive years tended its infantile and toddling footsteps, and to whose fostering care in after years we all know much of its success was due—need I say I refer to the George Washington of our tiny republic, the enthusiastic President of the Sociological Section? But, much as you all respect and admire Mr. Hughes, and look back with satisfaction on his long and useful association with our labours, I think it has unaccountably been reserved for a lucky thought of mine to discover that this year Mr. Hughes has to celebrate the Silver Wedding of his connection with our Society. It is now exactly twenty-five years since the title, "The Birmingham Natural History Society," came into existence. We ought not, I feel sure, to let this year slip by without in some

* Read before the Birmingham Natural History and Microscopical Society, March 5th, 1889.

suitable manner commemorating an event which does equal honour to Mr. Hughes and to the Society. We all remember how, some time ago, John Bright celebrated the Silver Wedding of his union with Birmingham, and surely it is not less fitting that we should mark with equal emphasis, so far as our power permits, a similar occurrence in the life-history of our first and four-times President.

It needs not that I should pass in particular review the names of the Presidents who have succeeded him; in Mr. Allport, Mr. Marshall, Dr. Hinds, Mr. Wills, Dr. Crosskey, Dr. Deane, and Mr. Lawson Tait, not to mention others more recent and better known to the present generation, we have a list of which any society like ours might well be proud. About the Society itself, it is a great pleasure to be assured, by the concurrent testimony of all whom I have spoken with, that, on the whole and taking into account the position in which we are placed, there is little to be desired except an increase in the membership. It should always be kept in mind that one of the objects of such a Society as ours, is the mutual pleasure as well as the profit of the members. Of course, we also keep before our eyes the advancement of Natural Science in the abstract, and are ready to do all we can to contribute to that end; moreover there can be no question that our Society does afford needful help in that direction, if only by providing opportunities for that study of books and mutual discussion in which the solitary student finds himself most at a loss. But contemporaneously, and in no less degree in my opinion, ought we to take care to provide for that other object, the pleasure, the rational and intellectual pleasure of our members—and one of the conditions precedent required for the attainment of that end is the suppression or removal from our midst of all unworthy jealousies, all factious disagreements, all strivings for the mastery. It is for this reason that we taboo all references to religious or political subjects, and we can at least take this credit to ourselves, that it is but very rarely that anyone violates this prohibition. I claim, then, that such a Society as ours should not be conducted on such rigid and stern financial lines as would be necessary if it were a purely business concern; we should not indeed run into debt, but with that exception we should cultivate such a spirit of tolerance and mutual forbearance with one another's weaknesses and hobbies as will enable us to live together, a peaceable and happy family.

It is now my intention to ask you to listen for a short time to some account of the progress in recent years of the

latest born of the sciences—I mean that which bears the somewhat cumbrous title of Bacteriology. Our attention will be confined mainly to certain questions of their physiology and modes of occurrence, upon which now our knowledge is more exact than it was some years ago.

Bacteria (more properly called Schizomycetes) are minute cells devoid of nuclei, which are able to derive their nitrogen from ammonia compounds, and are therefore not animal but vegetable cells. They are also devoid of chlorophyll, and therefore belong to the group called Fungi. A great part of their substance consists of water, even as much as eighty-three per cent. Of the dried constituents we find—

A nitrogenous substance	84·20
Fatty matter	6·04
Ash (mineral)...	4·72
Undetermined	5·04
	100·00

The only one of these which calls for particular description is the nitrogenous substance, which is analogous to the protein of other members of the vegetable kingdom, and is therefore called Mycoprotein. It forms the essential constituent of the protoplasm; it varies slightly in different species, but so far as is known at present contains no sulphur or phosphorus. The cell-wall usually consists of cellulose, but according to Nencki the cell-wall of the putrefactive Bacteria consists of a mixture of cellulose and mycoprotein. It is certain at any rate that the wall of the latter is acted upon by various staining agents which also act similarly upon the cell-contents, while in the case of the other Bacteria the cell-wall and the cell-contents are differently affected. Vincenzi states that the cell-walls of *Bacillus subtilis* contain *no* cellulose, and thus they approach the character of the cells of animals.

The cell-contents are protoplasm (chiefly consisting of mycoprotein) and various inorganic substances in minute proportions, such as the salts of potash, lime, soda, magnesia, or iron. A few species contain starch granules, and are coloured blue by iodine; others contain pure sulphur in the form of non-crystalline granules. The colouring matter of most coloured Bacteria is external to the cell, being of the nature of an excretion; but in a group, of which *Beggiatoa* (*Clathrocystis*) *roseo-persicina* is the type, it exists dissolved in the protoplasm, and is of a peculiar nature. The ordinary pigments of Bacteria can only be developed by the aid of free

oxygen; that is, the microbe produces a chromogenous substance which is oxidised into a pigment; some of them can be forced to grow in the absence of oxygen, and in that case the characteristic colour is not produced.

Bacteria require for their growth carbon, oxygen, hydrogen, nitrogen, and minute quantities of various minerals. Many of them require free oxygen; others can obtain it from the oxidised compounds of the medium in which they live; the first kind are called aërobic, the second anaërobic, but the distinction is not an absolute one. The nitrogen can be assimilated either from albuminous substances, or from ammonia and ammonium salts. They can grow in Pasteur's solution, and thus are capable of obtaining their nitrogen from inorganic substances. The carbon they obtain from sugar, glycerine, or from more complex organic bodies. Water is also essential to their growth, but desiccation does not necessarily kill them, although it does the comma-bacillus of Asiatic cholera. One of the reasons why sugar preserves from putrefaction is that it combines greedily with the water of the preserved substance, and thus hinders any germs that may be present from developing by depriving them of one of the essentials of their growth. Nine or ten kinds of Bacteria are now known which are phosphorescent, and in fact are the cause of the phosphorescence of putrid fish. Cultivated on a plate, in the manner hereafter described, the little colonies shine in the dark like stars in a midnight sky. They can even be photographed by the light they emit.

It has been shown that direct sunlight is fatal to the putrefactive Bacteria, and even to some of the pathogenic species. But on the other hand several species are known which flourish better in the light than in the dark. Engelmann has investigated these, and gave to the one on which his chief observations were made the name of *Bacterium photometricum.* The Beggiatoa previously mentioned, which is common in some stagnant pools, is another species. They all belong to the sulphur Bacteria, which, in the presence of free hydrosulphuric acid, become filled with sulphur granules. Some of these sulphur Bacteria are colourless, but others are characterised by a peculiar peach-purple pigment, diffused in the protoplasm, which is called Bacterio-purpurin, and is capable of acting somewhat in the same way as chlorophyll. When they are exposed to light there is found to be an evident proportion between the amount of light absorbed, and the physiological effect produced. In the absence of light they ultimately perish. The peculiar effect of light upon them is due to its direct

absorption, and does not depend upon the presence of sulphur, but upon the presence of Bacterio-purpurin. By its aid, in fact, they give off oxygen, and oxidise the sulphur to sulphuric acid. The elimination of oxygen is found to be proportionate, for different wave-lengths, to the absorbed energy of the light. Bacterio-purpurin, therefore, is a true chromophyll, and is capable of acting, like the colouring matter of Diatoms and the red Sea-weeds, in somewhat the same way as chlorophyll. But it is known that in the latter two chlorophyll is present, though masked by the other colouring matters. In Bacterio-purpurin, however, chlorophyll is entirely wanting. These experiments produce unexpected results, and may require confirmation; but that they must not lightly be rejected is enforced by two other facts equally contrary to our usual hard and fast rules, viz., that three organisms which exactly resemble Bacteria, and which even De Bary includes among them, are coloured by real chlorophyll, and that several others (which, strange to say, do not contain chlorophyll) are capable of producing in their protoplasm a substance which is usually called starch, and which if not starch, or the "granulose" constituent thereof, is, at any rate, very closely similar to it.

But most Bacteria act like Fungi, requiring oxygen, and therefore would be able with advantage to live in symbiosis with Algæ. The only instance yet recorded of what is believed to be such a connection is that of Glaucothrix with *Bacillus muralis* on the walls of a greenhouse; the connection here, however, was of a looser nature than that symbiosis of Algæ with Fungi, which constitutes the Lichens.

(To be continued.)

FORAMINIFERA OF OBAN, SCOTLAND.*

BY E. W. BURGESS.

At the end of 1887 and the beginning of 1888, I was entrusted with the material, No. 49, from 20 fathoms depth, near Dunstaffnage, Oban Dredgings (Birmingham Microscopical Society, 1883), to discover what Foraminifera it might contain.

I have washed the material, made a slide of the different species, containing 67 specimens, which is presented to the Society, and I now add a few remarks upon the several specimens, with references to the following papers upon the subject.

* Transactions of the Birmingham Natural History and Microscopical Society, read 6th June, 1888.

To avoid lengthy repetitions, only the name of the author and date are repeated.

Williamson, C. W., Recent Foraminifera, Gt. Britain (Ray Soc.), 1858.

Robertson, D., Fauna, West of Scotland, Trans. Geo. Soc., Glasgow, p. 51, 1874.

Robertson, D., Proc. Nat. Hist. Soc., Glasgow, 1881-3.

Wright, J., Proc. Belfast Nat. Field Club, 1880, etc.

Balkwill, F. P., and Millett, F. W., Foraminifera of Galway, Jour. Mic. and Nat. Science, 1884.

Balkwill, F. P., and Wright, J., Foraminifera, Coast of Dublin and Irish seas, Trans. Roy. Irish Acad. (Science), 1885.

These interesting subjects for microscopical examination are found in all parts of the world, both at the bottom and also on the top of the seas (pelagic); also forming a great portion of many of the geological strata of the world.

From the lime contained in the sea-water they construct a test, or shell, of extreme beauty in most cases; in others they collect the lime into such peculiar forms that they might often be mistaken for minute water-worn bits of stone (Nubecularia, etc.); or cement, either minute or coarse grains of sand, or smaller shells of foraminifera together, to form a dwelling for themselves, which, in a living state, is surrounded by a jelly-like mass; and they throw off through it and the test pseudopodia or threads of their bodies, crossing threads, in search of food, from which the name Reticularian Rhizopoda is given to them in their classification in the animal kingdom.

Perhaps of all persons who have given their minds to the study of the living forms in this country, Mr. J. D. Siddall deserves the greatest thanks, for the life-history of the Shepheardella tæniformis, Quart. Jour. Mic. Science, 1880. Many others, not having the opportunity of keeping them alive, have resorted to the study and classification of the dead shells.

The bottom of the sea, at the place where the dredging was made, consists of dead and broken shells, Entomostraca, sand, and mud.

I have added Mr. D. Robertson's remarks, if recorded, such as common, abundant, rare, etc.

I have also to record my thanks to Messrs. J. Wright and H. B. Brady for their kind assistance.

Description of the Specimens.

1. *Biloculina ringens.* Lamarck, 1804.
   Williamson (R. F.), 1858, p. 79, pl. vi., figs. 169-70-71.
   Balkwill and Wright (J. F.), 1885, pl. 12, figs. 6-7.
   Robertson. D. (W. S.), 1874, common.
   Prof. Williamson's figures give a good guide to the knowledge of this species, and as Mr. J. Wright remarks the *B. elongata* is merely an elongated form of *B. ringens*, and as the two forms pass into each other they can only be considered as varieties of one form. Common.
2. *Biloculina depressa.* D'Orbigny, 1826.
   Williamson (R. F.), 1858, p. 79, pl. vii., figs. 172-4.
   Balkwill and Millett (Galway), 1884, p. 5.
   Robertson, D. (W. S.), 1874, common.
   An oval, flattish form, with sometimes a broad carinate edging on each side. Common.
3. *Spiroculina limbata.* D'Orbigny, 1826.
   Williamson (R. F.), 1858, p. 82, pl. vii., fig. 177.
   Robertson, D. (W. S.), 1874, common.
   Oban, 1883. Very rare.
4. *Miliolina trigonula.* Lamarck, 1804.
   Williamson (R. F.), 1885, p. 84, pl. vii., figs. 180-2.
   Robertson, D. (W. S.), 1874, common.
   Oban, 1883. Not common.
5. *Miliolina oblonga.* Montagu, 1803.
   Williamson (R. F.), 1858, p. 84, pl. vii., figs. 186-7.
   Robertson, D. (W. S.), 1874, frequent.
   An elongated form, allied to *M. seminulum.* Rare.
6. *Miliolina seminulum.* Linné, 1767.
   Williamson (R. F.), 1858, p. 85, pl. vii., figs. 183-5.
   Robertson, D. (W. S.), 1874, common.
   Oban, 1883. Frequent.
7. *Miliolina subrotunda.* Montagu, 1803.
   Balkwill and Wright (J. F.), 1885, p. 324, pl. xii., figs. 8-9.
   Balkwill and Millett (G.), 1884, p. 6.
   Robertson, D. (W. S.), 1874, common.
   Often very circular in outline. Common.
8. *Miliolina secans.* D'Orbigny, 1826.
   Williamson (R. F.), 1858, p. 86, pl. vii., figs. 188-9.
   Balkwill and Millett (G.), 1884, p. 6.
   Robertson, D. (W. S.), 1874, frequent.
   A peculiar, large flattened form. It is proposed by M. Schlumberger to place it with others under the generic name Sigmoilina (*Sigmoilina secans,* D'Orbigny). Rare.

9. *Miliolina ferussacii.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 88, pl. vii., fig. 196.
Balkwill and Wright (J. F.), 1885, p. 325, pl. xii., figs. 10-12.
Robertson, D. (W. S.), 1874, rare.
This form seems to have many peculiarities, but always the outer edge very flat. Very rare.

10. *Miliolina tenuis.* Czjzek, 1847.
Balkwill and Wright (J. F.), 1885, p. 324, pl. xii., figs. 3-5.
Siddall, J. D., Foraminifera, River Dee, Proc. Chester Soc. Nat. Science, Part II., 1878, p. 6.
Robertson, D., Portree Bay, 1880, abundant.
Brady, H. B. (Syn. Brit. For.), Roy. Mic. Soc., 1887, p. 822.
Schlumberger. *Sigmoilina tenuis*, Czjzek.
J. D. Siddall remarks: "An extreme enfeeblement of *M. seminulum*," etc.
H. B. Brady: "There may be some doubt whether such forms are better placed amongst *Miliolinæ* or *Spiroloculinæ*." Rather rare.

11. *Miliolina bicornis.* Walker and Jacob, 1798.
Williamson (R. F.), 1858, p. 87, pl. vii., figs. 190-2.
Robertson, D. (W. S.), 1874, common.
Oban, 1883. Rare.

12. *Planispira celator.* Costa, 1855.
Wright, J., Fauna, S.W. Coast, Ireland, 1886, Proc. Roy. Irish Acad., ser. 2, vol. iv., p. 608.
Robertson, D., Portree Bay, 1880.
Often liable to be mistaken for *Miliolina agglutinans.* The test is oval, with pointed ends produced in opposite directions, sides convex, and the edge thin. Rare.

13. *Cornuspira involvens.* Reuss, 1849.
Balkwill and Wright (J. F.), 1885, p. 327, pl. xii., figs. 2A, 2B.
Balkwill and Millett (G.), 1884, p. 5, pl. i., fig. 1.
A long, whitish tube, coiled in a disc-like form on its smaller end, producing a concave surface, quite distinct from its congener, *C. foliacea.* Rare.

14. *Psammosphæra fusca.* Schulze, 1874.
Brady, H. B., 1879, Quart. Jour. Mic. Science. Vol. xix., N.S., p. 27, pl. iv., figs. 1-2.
Balkwill and Wright (J. F.), 1885, p. 327.
Robertson, D., Portree Bay.

An arenaceous form, composed generally of rather large grains of sand, cemented together into a spherical mass. Very rare.

15. *Reophax scorpiurus.* Montfort, 1808.
Brady, H. B., 1864. Trans. Linn. Soc., London. Vol. xxiv., p. 467, pl. xlviii., fig. 5.
Balkwill and Wright (J. F.), p. 328, pl. xiii., figs. 5A 5B.
Robertson, D. (W. S.), 1874, common.
Mr. Brady remarks (Rep. Chall.): "The general contour and minuter characters of the test of *R. scorpiurus* depend in great measure upon the locality in which it is found." Not common.

16. *Reophax fusiformis.* Williamson, 1858.
Williamson (R. F.), 1858, p. 1, pl. i, fig. 1.
Considered by many persons to be a starved, shallow-water variety of *R. scorpiurus.* Not common.

17. *Reophax nodulosa.* Brady, 1879.
Brady, H. B., 1879, Quart. Jour. Mic. Science, Vol. xix., N.S., p. 52, pl. iv., figs. 7-8.
Robertson, D., Portree Bay, 1880; also Frith of Clyde, very rare.

18. *Haplophragmium pseudospirale.* Williamson, 1858.
Williamson (R. F.), 1858, p. 2, pl. i., figs. 2-3.
Balkwill and Wright (J. F.), 1885. p. 330, pl. xiii., figs. 6-8.
Common on the West Coast of Scotland, 30 to 60 fathoms. The specimens from Oban, 1883, are very fine. Very common.

19. *Haplophragmium canariense.* D'Orbigny, 1839.
Williamson (R. F.), 1858, p. 34, pl. iii., figs. 72-3.
Robertson, D. (W. S.), common.
A nauticuloid form, each coil consisting of 6 to 9 segments, the outer coil often enclosing the earlier ones, generally of a bright orange brown colour.
Common to muddy bottoms. Very rare.

20. *Textularia sagittula.* Defrance, 1824.
Williamson (R. F.), 1858, p. 75, pl. vi., figs. 158-9.
Balkwill and Wright (J. F.), 1885, p. 332, pl. xiii., figs. 15-7.
Robertson, D. (W. S.), 1874, common.
Allied to *T. gramen*, d'Orbigny, but having its sides more parallel, margins more acute, and in form longer; opaque; not distinctly arenaceous. Not common.

(To be continued.)

IN SHERWOOD FOREST.

BY OLIVER V. APLIN,

MEMBER OF THE BRITISH ORNITHOLOGISTS' UNION.

(Concluded from page 58.)

A far more interesting game-bird is still found in the district. Some three or four miles south-east of Mansfield lies a wide tract of undulating ground, partly heather-clad, partly gorse and bracken-covered, with extensive young plantations of larch, spruce, and fir; and, here and there, topping the higher slopes, patches of oak-scrub, spruce, Scotch fir, &c.; this is Mansfield Forest. The air is fresh and strong, tainted sometimes in spring by the pleasant scent of a newly-burnt patch of heather. Poor and sandy as the soil is in most places, it supports a few sheep, the forest mutton having a well-deserved local reputation, and plenty of rabbits. Here the old race of forest Blackgame still lingers, not yet re-invigorated by any infusion of fresh blood, though it is feared that this expedient must be resorted to if the breed is to be kept up. It is a fortunate individual indeed who chances to see half-a-dozen old Blackcocks feeding out on the sandy fields at the edge of the forest, as has more than once happened to my host in that neighbourhood. I have myself on several occasions been lucky enough to come across Grey-hens, springing one once not five yards from my feet; and, on a fine evening in May, a single Blackcock was pointed out to me at the edge of a field of young barley, the sun glinting on his shining breast.

The Whinchat is common on the banks and slopes, but the Stonechat is strangely scarce, while the white upper tail-coverts of the Wheatear occasionally catch the eye as the birds flit on in front. Ascending a purple slope of heather one August day, I saw a Ring Ouzel perched on a sprig of whin, which, on our near approach, flew on and dropped in the heather. Although scarce here, this wild thrush, most at home on the mountain and the fell, has been known to breed about that spot, and the red berries of the rowan trees are so tempting as to overcome his shyness, and draw him down to the wood edges and even into ornamental grounds.

Scattered over the forest, in the hollows, are some lone ponds, bordered with rushes and merging in places into boggy

ground. A long and nearly circular chain of ponds, not far from Harlow Wood, interspersed with patches of bog, clothed with bilberry, wax-heath, and waving cotton grass, and in places with alder and sallow bushes, and partly joined by a rapid trout stream rising in Thieve's Wood, runs through the cultivated fields. Here, besides the common Wild Duck and the Teal, the Shoveller and the Tufted Duck breed in some numbers ; the little Grebe also, and the Moorhen and Coot, while the Snipe nests annually in the bogs. A couple of downy young of the latter, taken here by a farm boy, are now, through my friend's kindness, in my collection, and I have a vivid recollection of unsuccessful searches after the nest of a pair on two bright spring evenings. On each occasion the hen bird managed to slip off unobserved, while we were stepping carefully about on the treacherous ground. Once safely off the nest, she remained circling round overhead in the clear sky, uttering a very curious note, *cuck*, *cuck*, *cuck*, and entirely distinct from the *whituk*, *whituk*, uttered on the ground.

In the course of a walk round the ponds in spring I have counted as many as eleven pairs of Shovellers, and this without visiting the outlying forest pools. There can hardly be a more pleasing sight for the ornithologist than a pair of these beautiful ducks quietly floating on the water under the bank of some alder-bordered pond ; the many and varied colours of the drake being seen to equal advantage whether bathed in the brilliant morning sunshine, or slightly reflected in the smooth surface of the water under a quiet, grey, evening sky. Presently they rise upon the wing, their monosyllabic flight-cry sounding like *tuck*, *tuck*, *tuck* ; once or twice they wheel round us overhead, then sink gently down to alight on the further end of the pond. It is only recently that the nest of the Shoveller has been found in this neighbourhood, for the duck strays away when about to go to nest, laying her eggs generally in mowing grass in the water meadows, and does not bring her young down to the water until nearly full grown. No better or pleasanter spot could be chosen for the observation of the breeding habits of the Tufted Duck than the garden of the old forest "lodge" at Rainworth, where the owner has enjoyed unexampled opportunities of studying the natural history of these neat little black and white ducks. Here, seated under the beech trees down by the water-side, an early summer morning may most enjoyably be whiled away in watching the pair or two which frequent this water. Some time, of course, in each day is spent in actively diving for food, the ducks generally remaining under water some fifteen or

twenty seconds. In winter, Indian corn is supplied to the birds on the lake, and is eagerly shared by the tufties. Walking along the bank at the upper end of the water one morning, we witnessed a curious incident. A pair of Tufted Ducks, which were feeding, came up with a splash close to us, the duck with something hanging out of her bill, which we soon saw was a river lamprey, some four inches long. Twice did *Fuligula* succeed, with difficulty, in entombing this lively mouthful, and twice did the latter wriggle up into the outer world again, and dangle wildly in the air ; the third attempt, however, was more successful, and the duck managed to keep down her slippery meal. No one who has ever had a lamprey fix on his hand with its powerful sucker can help wondering what that duck's sensations were ! Lampreys are plentiful in this water. In spring they ascend the clear, rapid, trout stream to deposit their spawn on the gravel, and clusters of them can be seen at that season clinging on to some suitable pebble sufficiently large to maintain a firm position in the bed of the stream. Later on they drop back into the pond, and apparently pass the rest of the year in the sand at the bottom.

But to return to the Tufted Ducks. After feeding, a period of repose is indulged in, when with necks lowered and heads resting on their shoulders, they float placidly on the water, the snow-white flanks of the male contrasting sharply with the glossy blue-black of his upper parts. The drake in spring has a curious habit of elevating his bill and uttering a succession of rather musical notes—a kind of love song. During the few days I had a pair under pretty close observation one year, the duck went on to her nest between ten and eleven in the forenoon. At Rainworth the nest is usually placed on the island, under the shelter of the rhododendrons, and is formed of dead leaves of this shrub and of grass, with a warm lining of down added as the eggs are laid. These vary in number from eight to thirteen, and the clutch is seldom complete before the beginning of June, and often not until the middle of that month ; for although the Tufted Duck pairs in March, it does not go to nest until considerably later. The young, when hatched, are taken out upon the water by their parent; the former are proficient in diving and do not seek the shelter of the rushes when alarmed, as is the case with the common Wild Duck. The larger the pond the wilder the ducks, says my mentor, and certainly it is not very easy to approach even the paired birds in spring upon one of the more extensive sheets of water. But as five or six pairs may sometimes be seen there close together, it is worth while to stalk them. With Tufted Ducks at this season the female

takes precedence, swimming always a few feet in advance of her devoted partner. Presently they take the alarm; *curr-ug curr-ug*, now they are up and off, the duck invariably (again I quote my host, albeit having had ample opportunity of testing the truth of the observation) rising first, hurrying along near the surface of the water, with rapidly beating wings, before rising higher in the air, and finishing the flight upon motionless, much-bent pinions, as, with a little twist or two from side to side, they slant downwards to pitch with a splash on the water.

Black-headed Gulls, stragglers probably from one of the "gulleries" in the neighbouring county of Lincoln, are sometimes attracted by this marshy, pool-studded belt of country. Even in early June I have seen this species, wearing the distinctive brownish-black hood peculiar to the breeding season, fly over quite low down, and evidently only deterred from alighting by our unwelcome presence.

Many uncommon birds visit the ponds. One day towards the end of April, a pair of Black Terns had tarried here for a few hours, and were busily skimming over the water with the Swallows, which, in company with the delicate little Sand Martins, love to hawk for flies over the ponds in cold spring weather; among them, on one occasion, was a Swallow with a white tail. When walking round the ponds early in August, we flushed a male Wigeon in the rufous summer plumage, which had probably remained there all summer. Thinking over the Tufted Ducks calls up recollections of fine bright evenings at Rainworth in early summer, when, as we stand on the bank of the pool, the glow of sunset throws into relief every branch and leaf in the plantation opposite. Against the brilliant sky a "drumming" Snipe is clearly silhouetted, and we can distinguish the Guinea fowls roosting in the Scotch firs on the other side of the pond, across which they regularly fly at dusk. The Thrush, the Cuckoo, the babbling Sedge-bird, and the Grasshopper Warbler's incessant reel mingle with the mellow call of the Peewit on the upland fallows and the drumming of the Snipe. Swallows, belated, and bats flit over the water, broken by the splash of the trout throwing themselves sportively out of the water, or leaping at the infrequent fly. Perhaps you may be lucky enough to see a Nightjar skimming on noiseless wings over the pond, in pursuit of the moth and chafer, and you may often catch the whistling sound of ducks' wings as they fly overhead. The vocal chorus is continued far into the still, warm nights, and at midnight the "reel" of the Grasshopper Warbler, rising and falling, came in waves of sound; the Sedge Warbler chattered

on, Coots clanked, now and then the "chuckle" of a Moorhen or the subdued quack of a Wild Duck was heard, and the distant call of the Peewits smote softly on the ear.

One summer four pairs of Grasshopper Warblers were nesting round the house, and I once had an interesting interview with this shy species at closer quarters than it has been my luck to be on any other occasion. While the male of a pair, which haunted a little osier bed, was singing loudly one evening. I managed to creep close up to it, along the boundary hedge, and, after severel cursory sights of it as it flitted about among the osiers or crept in a mouse-like way up the slender wands, I at length marked it in the hedge. Pushing my face cautiously in among the leafy twigs, I found myself within eighteen inches of the bird, which showed up clearly against the light as it sat in a rather upright position singing loudly. During the delivery of the "trill" the bill is open to its widest extent, and the mandibles are motionless. The head meanwhile is slowly turned from side to side, and this, and the varied pitch at which the song is delivered, produces the ventriloquism often spoken of.

Truly this is a land of oaks, and many are the venerable specimens celebrated in local tradition. On this side of the forest the most noted is, perhaps, that under which King John held a Parliament; but a finer sight by far is presented by the famous trees locally known as the "Hayward Oaks," which are scattered over the paddocks around a farmstead near Blidworth. Some two hundred in number, they are said to date back to the time of the Conquest, and though long past their prime, the spreading branches of many of them still cover wide spaces, and they are annually clothed with fresh rich green; some of them of enormous girth, in their gnarled and rugged beauty this collection of ancient oaks can, perhaps, hardly be matched anywhere in England. Many Stock Doves breed in the hollows of the oaks, and here a very curious hybrid, between one of these birds and a dovecot pigeon from the farmstead, was reared a year or two ago. It had been seen frequenting the oaks for some little time, and was at last with difficulty secured, as it was very wild. A coloured figure of this bird is given in Mr. Mosley's work on "British Birds."

Tradition assigns to the neighbourhood of Rainworth the scene of some of Robin Hood's exploits. The Cave Pond, a favourite resort of Shovellers, &c., is locally believed to have been the one across which Friar Tuck was compelled to carry that worthy on his shoulders; and "Bishop's Hill," where the prelate danced with assumed and unfelt gaiety, is close at hand.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(*Continued from page 68.*)

We must now return to Mr. Edwin Lees and his further contributions to the Botany of the County.

In the year 1842 he published the first edition of the "Botanical Looker-out among the Wild Flowers of the Fields, Woods, and Mountains of England and Wales." A second edition appeared in 1851. In this work the author notes the most striking species which appear in flower in the successive months of the year, in various parts of England and Wales. It may be inferred from pages 94 and 95 of the first edition (pp. 138, 139 of the second) that the following trees, not previously recorded, occur in Worcestershire :—

Lime. Tilia intermedia.

Blackthorn. Prunus spinosa.

Alder. Alnus glutinosa.

Beech. Fagus sylvatica.

Hazel. Corylus Avellana.

The next work of the same author is the well-known "Botany of the Malvern Hills." Of this there are three editions, none of which bear a date on the title page. The prefaces are dated respectively May 12th, 1843; August, 1852; July 31st. 1868.

This work is of some importance in the history of Worcestershire Botany. It is the first in which all the plants are recorded, and the first also in which any attempt is made to discriminate the Rubi. Mr. Lees enumerates, in the first edition, 786 species of flowering plants and ferns as growing in the Malvern District. Those from adjoining parts of Hereford and Gloucester are admitted, and there is some difficulty in distinguishing them. Very few localities are mentioned in the first edition; these I have added where necessary from the second and third. I have omitted many of the commoner species which have been previously noted. The author explains that "where the capital E is placed after a plant it signifies that it is confined to the eastern side of the hills; W to the western side; H denotes that it is limited to the hills themselves or to their protruding rocks."

Edwin Lees, in the "Botany of the Malvern Hills," 1st Edition, 1843.

Plants also recorded in Mr. Lees' Catalogue in Hastings' "Illustrations of the Natural History of Worcestershire" are distinguished by the letters Ill.

* Clematis Vitalba, p. 28. Ill.

* Thalictrum flavum, 28. Longdon Marsh. Ill.

* Myosurus minimus, 21. E. Rare.

Ranunculus aquatilis, β. pantothrix, 28. In little pools on Welland Common.

R. circinatus is intended here. See 3rd Edition, p. 77.

* R. fluitans, 28. With stems many feet in length. Occurs in the Teme at Powick.

R. sceleratus, 28.

R. Flammula, 28.

R. auricomus, 28.

R. acris, 28.

R. bulbosus, 28.

R. hirsutus, 28. (2nd Edition, 60. I have only gathered R. hirsutus in a barren pasture bordering on Longdon Marsh.)

* R. parviflorus, 28. (2nd Edition, 60. Not very uncommon on dry banks, as about Barnard's Green and Powick.) Ill.

R. arvensis, 28.

* R. Ficaria, 28.

Caltha palustris, 29.

* Helleborus fœtidus, 29. This I have received, as growing at Cotheridge, from John Walcot, Esq., of Worcester.

* Aquilegia vulgaris, 28. Borders of woods, westwards, both with purple and white flowers. Ill.

* Delphinium Consolida (*D. Ajacis*), 28. Rare. E. Ill.

* Papaver Rhœas, 28.

* P. dubium, 28.

P. Argemone, 28.

* Corydalis claviculata, 34. On the declivities of the North Hill. Ill.

* Fumaria capreolata, 34. Ill.

F. officinalis, 34.

Brassica campestris, 33.

B. Rapa, 33.

* B. Napus, 33.

Sisymbrium officinale, 33.

Erysimum (*Sisymbrium*) Alliaria, 33.

* **Cheiranthus Cheiri**, 33. Little Malvern Priory, but scarcely wild.

* **Cardamine impatiens**, 32. This is quite a common plant all about the eastern bases of the hills.

C. sylvatica, 32. Ill.

Arabis thaliana, 33.

Barbarea vulgaris, 33.

Draba verna, 32.

* **Königa maritima** (*Alyssum maritimum*), 32. In the lane near the Chalybeate Spa, in 1841. Ill.

Capsella Bursa-pastoris, 32.

Lepidium campestre, 32.

* **L. Smithii**, 32.

* **Senebiera Coronopus**, 32.

*† **Reseda lutea**, 23. Found by W. Addison, Esq., but it must be very rare, for I have failed ever to observe it myself.

> *I suspect an error. It is not acknowledged as a Malvern plant in Lees' "Botany of Worcestershire."*

‡ **R. fruticulosa**, 23. I have gathered this at Worcester. *Not native.*

* **Cistus Helianthemum** (*H. Chamæcistus*), 28.

*† **Viola canina**. 18. *Viola sylvatica, Fries, is doubtless intended here. See Scott's list, "Midland Naturalist," Vol. XI., January, 1888, p. 17.*

V. flavicornis, 18. *This must be V. flavicornis, Forster, a variety of the last.*

* **V. arvensis**, 18. *See Scott's list above referred to.*

Polygala vulgaris, 34. Frequent on the western side of the range, with red flowers. *Doubtless the typical species. See Walker's list, "Midland Naturalist," Vol. XI., April, 1888, p. 121.*

* **Drosera rotundifolia**, 21. In the bog at the western base of the Worcestershire Beacon. Ill.

* **Dianthus Armeria**, 22. In pastures below the Abbey Church, but rare. Ill.

* **Saponaria officinalis**, 22. Between Worcester and Cotheridge, not far from Mudwall Mill. Banks of Severn. Ill.

Lychnis dioica, 23. Red and White Campion.

> *This must be accepted as a record for both the following segregates :—*

L. diurna.

L. vespertina.

Agrostemma Githago, 23.

* **Moenchia erecta**, 16. In profuse abundance on the hills. Ill.

Cerastium semidecandrum, 23.

C. vulgatum, 23. Broad-leaved Mouse-ear Chickweed. *C. glomeratum, Thuil.*

C. viscosum *(C. triviale, Link)*, 23. See 3rd Edition, p. 60.

* **C.** *(Malachium)* **aquaticum**, 23.

Stellaria holostea, 22.

* **S. glauca**, 22.

S. graminea, 22.

* **Arenaria trinervis**, 22. Ill.

A. serpyllifolia, 22.

* **A. tenuifolia**, 22. Ill. *Mr. Lees gives no locality for this rare species, noted by Stokes, on Ballard's authority, as occurring on the Malvern Hills. It is not acknowledged as a Malvern plant in the 3rd Edition.*

* **A.** (*Spergularia*) **rubra**, 22. Ill.

* **Sagina apetala**, 16.

S. procumbens, 16.

* **Spergula** (*Sagina*) **nodosa**, 23. On the edges of various springs on the sides of the hills, especially of the western descent of the Worcestershire Beacon. Also on Welland Common. Ill.

† **S.** (*Sagina*) **subulata**, 23. *Noted, without locality, as a Malvern plant in all three editions, but not acknowledged as a Worcester plant in the "Botany of Worcestershire." An error ?*

* **Montia fontana**, 14. H. Ill.

* **Hypericum Androsæmum**, 36. Not uncommon in deep shady lanes about the Wells and Little Malvern, &c. Purlieu Lane. Ill.

* **H. calycinum**, 36. Little Malvern, but probably introduced. Ill.

* **H. dubium**, 36.

* **H. humifusum**, 36.

* **Malva moschata**, 33. Ill.

* **M. rotundifolia**, 33. Ill.

Tilia grandifolia, 28. In a field near the Priory Farm, Little Malvern.

T. europæa (*intermedia*), 28. In a natural wood at the N.E. base of the Warren Hill.

* **T. parvifolia**, 28. Undoubtedly wild in woods on the Old Storrage, on the banks of the brook above Bridge's Stone Mill, on Rosebury Rock, Knightwick, &c. Ill.

* **Linum usitatissimum**, 21. Occasional.

* **Geranium phæum**, 33. Near Cradley and Grimley. (2nd and 3rd Editions. By the side of a watery lane beyond Hales End, Cradley; Dr. Addison.)

Cradley is in Herefordshire.

* **G. pyrenaicum**, 33. (2nd and 3rd Editions. Under the hedge of a meadow by a footpath between Cotheridge and Bransford Roads, St. John's, near Worcester.)

G. molle, 33.

* **G. lucidum**, 33. Very plentiful on the rocks. Ill.

(To be continued.)

THE SEPARATION OF ROCK CONSTITUENTS BY MEANS OF HEAVY SOLUTIONS.*

BY T. H. WALLER, B.A., B.SC.

In investigating the history and geological relations of the crystalline rocks, the microscopical examination will sometimes show differences between masses closely similar in their average chemical composition—varying groupings of the elements being brought about in all probability by differences in the conditions of crystallisation and solidification. To take a simple example, the average composition of the ordinary Hebridean gneiss of the North-west of Scotland—what is generally termed the bulk analysis—agrees almost exactly with that of a normal andesite; such, for instance, as that from Montserrat, which I have shown here on two or three occasions.

In addition, therefore, to making a bulk analysis of a rock, it is frequently desirable to analyse the component minerals, so far as they can be separated.

For the purpose of this separation two lines of procedure have been used. In the one the powdered rock is allowed to stream between the poles of a tolerably powerful electro-magnet, which retains those minerals which contain iron in any notable proportion, allowing the others to pass freely. This requires frequent repetition before the separation is complete, and then leaves the problem of the separation of, say, quartz and felspar untouched. Nevertheless, it is a useful auxiliary to the other method, and an ordinary bar-magnet is serviceable in removing magnetite from other minerals.

The other course is that which I am to show to you this evening, namely, the use of heavy solutions.

* Transactions of the Birmingham Natural History and Microscopical Society, April 17th, 1888.

The solution I shall use is the double iodide of mercury and potassium which is made by dissolving 220 grammes of iodide of potassium in water, and adding to it 290 grammes of the biniodide of mercury. The scarlet iodide gradually dissolves, forming a yellowish liquid which is to be evaporated on the steam bath until it crystallises on cooling. The addition of a drop or two of water redissolves the crystals, and the solution may then by readily filtered through paper. It has a specific gravity of 3·196; that is to say, fluor spar floats on it.

By substituting the iodide of barium for the potassium salt, the specific gravity may be increased to over 3·5. In this case the proportions are 100 of iodide of barium to 130 of the iodide of mercury. The two salts are heated and shaken with 20 of water until they are dissolved, and then concentrated, if necessary, until topaz floats. In diluting the solution in the process of separation, an already diluted solution should be used to prevent a partial decomposition and deposit of the iodide of mercury, which is liable to occur when water is used.

Another liquid used for the purpose is the borotungstate of cadmium, which can be obtained with the specific gravity of 3·6. Its preparation, however, is very troublesome, and in using it all carbonates must be previously removed as they decompose the substance.

Biniodide of methylene has also been proposed as likely to be useful. It must be diluted with benzol, which may be evaporated off to obtain the substance ready for use again.

The next point to be considered is the preparation of the specimen of the rock.

This should be broken up in a mortar (a brass or bronze one of the tall shape is the best), and care must be taken to make as little actual fine powder as possible. By means of sieves the powder is separated and examined under the microscope, and the fraction must be chosen which is the largest grained; one which is homogeneous. This will generally be such as will pass through a sieve of forty or fifty meshes to the inch. The very fine powder must be sifted out, say, through a 100 mesh sieve.

Small beakers are taken, which should have a lip and hold about 1½ to 2oz.

Take about 30 c.c. of the solution and stir in the rock powder and a fragment of larger size of a mineral of known specific gravity to act as an "indicator." On settling, it will

probably be found that a separation has occurred; some of the constituents have fallen to the bottom of the beaker, the rest float. In the former fraction we have the ores, such as magnetite, ilmenite, pyrites, augite, and olivine. The floating portion consists of the felspars, quartz, with some of the subordinate minerals. This lighter fraction may be partially skimmed off with a glass or platinum spoon, and then the liquid is poured off the heavy part, which may be done pretty completely, usually leaving a ring of the lighter particles adhering to the sides of the beaker, interrupted, however, at the spout by a gap where the liquid was poured out. Through this gap, which should be made as wide as possible by gentle swaying from side to side while pouring, the heavy portion is washed into a porcelain dish by means of a wash-bottle. It is washed by decantation and boiling with water and a little solution of iodide of potassium, and then dried.

The addition of water, drop by drop, to the liquid on which the lighter part of the rock is floating, soon effects a separation, and, if this is continued till another "indicator" just sinks, we know to what specific gravity we have reduced it. In order to get the substances quite pure a repetition of the process is required. This may be suitably performed in a tube closed below by a stopcock, through which the heavier fraction may be run off.

To determine the specific gravity of a mineral, a fragment is floated on the solution and water added, drop by drop, with careful and thorough stirring, until the fragment rests indifferently anywhere in the liquid. Then fill a small specific gravity bottle or tube, and determine the specific gravity by weighing. A more simple plan, and one which is quite accurate enough for almost any purpose, is to use the principle of Westphal's balance, and weigh a plummet, of which the weight in air and the specific gravity (which must be greater than that of the liquid) are known, immersed in the liquid. The plummet for this purpose may be made of a glass tube containing mercury, and its specific gravity is, of course, previously determined by weighing in air and in water.

The determinations should be repeated, and it is obvious that, when the mineral fragment tends neither to sink nor rise in the solution, the specific gravity of the two is identical.

For the suggestion of the potassium iodide fluid we are indebted to Sonstadt, for that containing barium iodide to Rohrbach, and for the borotungstate of cadmium to Klein.

The solutions may also be of what is ordinarily termed practical use. For instance, we occasionally pick up on the seashore pebbles which have the colour and apparent lustre of topaz. The readiest means of determining whether it is this mineral or merely a coloured quartz pebble, is the test of specific gravity. Topaz sinks in the mercury potassium solution, while the quartz floats.

Wayside Notes.

BALEA PERVERSA (LINN.) IN NOTTINGHAMSHIRE.—Mr. G. W. Mellors has sent me specimens of this species from Staunton, near Newark, and from Kirkby in this county. This species has not hitherto been recorded for Nottinghamshire, although records have been made by the Conchological Society's referees for the adjoining counties of Lincoln, Leicester, Rutland, and Derby. From Kirkby the same gentleman has also sent me specimens of *Pupa ringens*, Jeff., the only locality, he states, around Nottingham where he has been able to find this species.—JOSEPH W. WILLIAMS, Mitton, Stourport, Worcestershire.

DEATH OF PROF. S. O. LINDBERG.—I regret to have to announce the death of the late eminent bryologist, Prof. Sextus Otto Lindberg, M.D., F.D., of Helsinfors University, who passed to his rest February 20th, 1889. This eminent botanist was born at Stockholm, March 29th, 1835, and by his own exertions raised himself from a comparatively obscure position to hold a high post at Helsinfors University, to be the most eminent European authority on mosses and hepatics, and to have the respect and admiration of botanists throughout the world. As a field botanist he was remarkable for his wonderful powers of observation; I believe I am right in saying that he rarely if ever used a lens, but could, with the unassisted eye, make out the most minute details of his plants. To the literature of botany his contributions were of unexceptional value ; space, however, will not allow of more than a passing glance at his work in this direction. At various times he contributed articles on Bryology to the "Journal of the Linnæan Society" and the "Journal of Botany." But his most valuable papers were communicated to the scientific journals of his own land, all of them abounding in original thought and evidences of original research. Among the more noteworthy are "Torfmossornas byggnad Utbredning och Systematiska Uppställning," a valuable paper on the Sphagnaceæ ; "Kritish Granskning af Mossorna uti Dillenii Historia Muscorum," most valuable as giving the modern synonomy of Dillenius' great work; "Musci Scandinavici in Systemate Novo Naturali Depositi," a full moss and hepatic flora of Scandinavia, with descriptions of many new species. "Monographia Metzgeriæ," "Observationes de formis præsertim europæis Polytrichoidearum," "Om de europeiska Trichostomeæ," "Sandea et Myriorrhynchus Nova Hepaticarum Genera," "Monographia præcursoria, Peltolepidis, Sauteriæ et Cleveæ," &c., &c. Throughout all these papers we have evidences of many years' close study in the exhaustive

synonymes of each species enumerated. Although many may differ with the learned doctor's nomenclature, all who knew him, either personally or by correspondence, will deeply regret his death.—J. E. BAGNALL.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, Feb. 19. Mr. T. H. Waller, B.A., B.Sc., chairman. Exhibits by Mr. Edmonds, a slab of red sandstone showing ripple marks, from the cemetery; Mr. W. B. Grove (on behalf of Miss Gingell), a fungus, Judas' Ear, from Dursley, Goucestershire; Mr. W. H. Wilkinson, a starfish with fourteen rays, a sea-mouse (Aphrodite), an octopus washed up at Llandudno after the late storm. A series of photographic views of coal mines was exhibited by Mr. Alfred Pumphrey. Notes on the Volcanoes of the Two Sicilies, by Dr. Tempest Anderson, of York, were read by Mr. W. P. Marshall. The views in both cases were shown on the screen by the aid of the oxy-hydrogen lantern by Mr. Chas. Pumphrey. Mrs. W. B. Grove and Miss Moseley were unanimously elected members of the Society.—ADJOURNED ANNUAL MEETING, Mar. 5. Mr. J. F. Goode in the chair. Mr. W. B. Grove, M.A., delivered his retiring address, which is printed in the present number.—BIOLOGICAL SECTION, Mar. 12. Mr. H. M. J. Underhill, of Oxford, gave a paper on "The Eyes of Insects and the Way they See," illustrating it by a series of photo-micrographs and diagrams as lantern views. These were shown on the screen by Mr. Charles Pumphrey, by the aid of the oxy-hydrogen lantern. There were also shown under microscopes a number of preparations from which the photo-micrographs had been taken. Mr. Underhill having first described the structure of the human eye and the simple eyes of the spiders, gave an account of the wonderful facetted compound eyes of the housefly and insects generally. He then gave the results of experiments he had made with the cornea of the compound eye of Dyticus, a water beetle, in order to test the action of the lenses of the individual cones or facets. He described the idea of the "mosaic" character of the image formed by these compound eyes, the image of each eye forming a single portion of the whole mosaic, and inferred that this idea was incorrect because the individual eyes would each form a reversed image of the portion of the object seen by it and the combined picture consequently be thrown into confusion. He thought it most probable that insects would not see with the whole number of their eyes at once, but that the brain would only receive the impression of the image formed by those most favourably situated for seeing in the direction to which the attention might at the moment be directed, in a similar way to the manner in which we are able to concentrate attention upon a part of the image presented by our eyes, without really *seeing* everything.—GEOLOGICAL SECTION, Mar. 19. Professor Chas. Lapworth, F.R.S., chairman. Mr. W. E. R. Martin, F.R.M.S, was proposed for membership by Mr. Alfred Hill, M.D., seconded by Mr. W. H. Wilkinson. Mr. Edmonds exhibited sandstone from cemetery with dendritic markings, and micaceous sandstone. Mr. T. H. Waller, B.A., B.Sc., read a paper on "The Petrology of the

Pebbles of our District." In the discussion which followed, this paper was characterised by Professor Lapworth as a very valuable addition to our knowledge of the Pebble Beds.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 18th. Mr. H. Hawkes presented to the Society a collection of two dozen microscopic slides of the Myxomycetes; a hearty vote of thanks was accorded the donor for his gift.—Feb. 25th. Mr. J. Rodgers read a paper on "Climate as Affected by the Inclination of the Earth's Axis." The author said the question of climate was so complicated a subject that it would be difficult to deal with it in a single paper. The local circumstances that affected climate were reviewed at some length and many illustrations given. When we compared the Earth with other planets we found a great family likeness, but the inclination of their axes varied considerably, this variation extending from 3° to 75°. The different planets were enumerated and their probable climates commented on. The writer held that the inclination of the Earth's axis was gradually diminishing, and gave ideal pictures of the course of climatic changes during 16,000 years; this period giving the greatest degree of heat and cold. The idea that a uniform winter ever prevailed for a number of years was combated, as it would not account for erratic boulders, and large deposits of river gravels. Several speakers dissented from these views, a discussion closing the meeting.—March 4th. Mr. H. Hawkes exhibited an album of mounted seaweeds; Mr. J. W. Neville, specimens of arenaceous foraminifera; Mr. H. Hawkes, preparation of *Lomentaria kaliformis* and *Codium tomentosum*, both marine algæ. —March 11th. Mr. J. Madison exhibited the following shells:—*Bithynia rubens* and *Neritina neritoides*, from Sicily; also *Melania bolonensis*, from New South Wales. Mr. Hawkes, mounted specimens of *Habenaria bifolia*, *Ruscus aculeatus*, *Botrychium lunaria*, and other plants. Under the microscopes: Mr. J. Moore, gastric teeth of grasshopper; Mr. J. Collins, fruit of *Chara vulgaris*; Mr. Hawkes, leaves of *Drosera rotundifolia*, with captive insects. Mr. Corbet showed a large specimen of brain coral, and fossil specimens of Favosites from Dudley. In the unavoidable absence of Mr. A. T. Evans, Mr. H. Hawkes read a paper on "The Pleasures of an Herbarium." What is the use of an herbarium? is a question often asked by those who see little to admire in the faded mummies of the beautiful flowers they represent. The pleasures of an herbarium are those of association. The yellow-horned poppy called to mind the boiling sea near which it was gathered; the orchis reminded us of the treacherous sphagnum in the marsh where it was secured, and so with all other plants. The writer said this was only considering it from a sentimental point of view, and the question remained, of what use is an herbarium? If we once gathered the plants ourselves, we became acquainted with their habitats, and gained a practical knowledge of botany we could not get by any amount of reading. To make our collection as complete as possible we are led into all sorts of places; to inquire into the introduction of plants and their distribution. It also leads us into many a bye-path of science, and brings us face to face with the world of microscopic fungi, the spiders that spin their webs on plants, and the insects and mites that make their cradles in the leaves. This subject opens up so wide a field that it might profitably employ the leisure hours of a life-time.

ON THE AUTUMN MIGRATION OF SWALLOWS AND MARTINS.*

BY W. WARDE FOWLER.

Ever since I was lucky enough, in September, 1885, to see something of the passage of migrating birds over the Alps of the St. Gothard district, I have kept a careful watch on the movements of birds in that month ; and more particularly on the journeying of the Swallows and Martins. These birds are comparatively easy to observe on migration, for they are almost always on the wing, and, even when they settle, usually prefer a conspicuous and airy place, such as a house roof, a church tower, or a tree from which the leaves have already in part fallen. Most other small birds seem to pass from our woods and hedgerows in some quiet and mysterious way, and to find their way to the coast gradually and silently, rarely startling the observer by allowing him to see them in packs, or in such rapid movement as could be recognised at once as *travel.* But the Swallows and Martins, if they are closely watched towards the end of September, may be observed, not only gathering and exercising themselves before their departure, but actually performing their daily journey ; and only patience and good opportunities are needed to enable us to discover something of the methods by which these journeys are conducted.

As a classical student, my experience has been, that if I fancy I have discovered something new in that department of learning, I almost always, sooner or later, find to my chagrin, that someone else—usually a German—has been on the ground before me. But no one seems as yet to have given his whole mind to this migration of the Swallow tribe, or at least to have recorded his observations in any easily available book or periodical. I am speaking, be it clearly understood, of England and Englishmen ; for we seem to know a good deal more of the course of migrating birds after they have left our island, than of the nature of their travel while they are still within it. We know something from the "Migration Reports" of their passage along the eastern and western coasts of the island ; but very little of their movements on the south coast, and almost nothing of the process by which they gather in the interior and find their way to the sea. What little I have noticed myself on the coast of Dorset, and inland in Oxfordshire, I propose to set down in this paper.

* Part of a paper lately read to the Oxford Natural History Society.

On September 20th, 1887, while staying at West Lulworth, half way between Weymouth and Swanage, I discovered that every Swallow and Martin which I saw was steadily travelling eastwards. They travelled in parties of from fifty to two hundred, just as I had seen them in the Alps, and as they are described in the "Migration Reports." I could trace these parties for a long distance with my glass, as I stood on a long and narrow ridge of down some five hundred feet above the sea; their general direction was always due east, though they seemed to follow pretty closely the long line of the down, which curves somewhat inland eastwards from Lulworth. The whole day they continued to pass, not in a continuous stream, but in these great packs, which at one moment were over my head and all around me, and in two or three minutes had almost unawares made half a mile's progress eastwards. They did not, of course, fly straight ahead in a direct course; they seemed to be ever dallying and circling round, sweeping backwards; yet you only had to keep a vigilant eye on them to discover that they were all the time moving onwards, and travelling at a rate which I guessed to be not much less than ten miles an hour.

On that day the wind was easterly, and therefore dead against them; but it was a gentle breeze, and they were able to fly without apparent effort at a considerable height. The next day the wind was stronger; and on the third day, if I recollect right, it was very keen and cold, and instead of soaring they changed their tactics and took to skimming low along the steep flanks of the down. From my post of vantage at the top, I watched with interest the way in which these delicate little birds withstood and conquered the force of a strong head wind. I can see them even now creeping along the shaggy sunburnt sides of that noble breezy down, tacking this way and that, now deep in the grassy hollows, now steering swiftly upwards, now yielding to the gale for a moment in a backward curve, but ever steadily pressing onwards. Some preferred a belt of lower ground between the down and the sea; but I noticed that where this comes to an end and the down itself falls again in precipitous cliffs direct into the waves, they all turned inwards again, hugging the hill, and not venturing to cross even a mile or two of sea to the further arm of the bay in the face of such a wind.

All this was so interesting that I wondered that I had never observed the same thing during previous visits to Lulworth in September. Diaries kept during those visits were at hand, but showed no trace of any such migration. Possibly I had missed the exact days on which the birds

were passing; but it is more likely, I think, that I simply failed to *notice* what was going on. The flight of these birds is so deviating that its *general* direction may very easily be missed, and, in fact, it is almost indispensable that the observer should be posted on some commanding height in order to appreciate it. I have seen the same kind of migration going on in the Midlands since that visit to Lulworth, but found it very difficult to follow and make sure of, owing to the want of such a point of vantage as that noble ridge of down.

Possibly the flatness of our midlands is the reason why so little is known of the actual lines of migration of the Swallow tribe *within this island*, and before they cross the sea. Are there any such regular lines, apart from those along our coasts? Do the birds alter their course according to wind and weather? Do they always travel in parties, and if so, how are those parties formed? Are they the birds of a single district, town, or village? Where do they rest at night—if, that is (as I believe) they do not usually travel by night? At what point, or in what neighbourhood, do they cross the sea to France?

I do not think it would be easy to find an ornithologist who would be prepared to answer any of these questions except at hap-hazard, or who has any precise records of observation on which he could base an answer. These things go on under our very eyes, yet we know nothing about them. I wrote a short letter to "Nature," describing what I had seen at Lulworth, and this letter was copied into the "Field" by Mr. Harting, who edits the Natural History column in that paper; yet to the best of my belief, no one has since then gone further into the matter. I made some little effort to organise a small army of observers for last September, and tried to enlist some ornithological boys at Marlborough; but boys in their holidays are not disposed to lurk about by themselves in the cause of science, and rarely have the patience needed for such work. I had hoped that, coming from all parts of the kingdom to a common centre just at that time, they might have brought with them a good many reports of what the birds were doing in their various neighbourhoods; which, when duly tabulated, might in course of time have produced valuable results. I do not despair, however, of getting something of this kind done, and would suggest the experiment to schools and colleges which meet at that time of year.

Of course I was on the look-out myself again last September, and though I saw little, that little was very

interesting. But before I go on to describe this, I will just state what I consider to be the explanation of the migration I saw in 1887.

I left Dorset that year on September 25th, and spent a few days in Devonshire, partly at Crediton, partly near Bideford. I looked carefully wherever I went for Swallows and Martins, but with the exception of half a dozen lingerers at Bideford, which is warm and sheltered, I saw none; the country was completely deserted by them. I think, therefore, that the great procession I saw at Lulworth must have consisted of the birds of Cornwall, Devon, and perhaps of Somerset (possibly also of South Wales), who were following the coast-line as a guide, and proceeding along it until they should reach a point where it would be convenient to cross the sea. It is a pretty well-known fact that the Pied Wagtails gather in something the same way along the south coast in their autumn migration; and in fact they were on their travels at Lulworth, though in small numbers, at the very same time when I was watching the Swallows. In other years I have sometimes seen them there in such vast numbers that a single field, which was being ploughed, seemed literally alive with them, and after several years' observation, I may hazard a conjecture that the Grey Wagtail takes the same track; for otherwise I cannot account for the regular appearance of these water-loving birds in a district so waterless as that of South Dorset, in the month of September, and in company with their pied cousins.

On returning from Devonshire to my Oxfordshire home, I found that considerable parties of Swallows and Martins were passing over the village at intervals every forenoon. Our own birds, which regularly gather on my house roof for a week or two before they leave, had apparently departed; but from north and west fresh companies continued to arrive, and it was long before we felt that "the Swallows had really gone." These strangers lingered a while about the village, generally in the neighbourhood of the church, and then took their departure in a south-easterly direction along the line of our valley. But, as I have already said, it was difficult to trace their line of flight, and impossible to follow it for any distance, owing to the want of a commanding hill whence I could sweep the whole country with my glass. I may mention that one day at nightfall I found a small orchard in a neighbouring village crowded with them; and, no doubt, this was a detachment, resting for the night, which would roceed on their way early next morning.

In 1888, I was again at Lulworth early in September, but the migration had not yet begun. After leaving it, I spent ten days in Exmoor, where the Swallows were still present in large numbers, but gathering for migration. At Withypool, in Exmoor, they had selected a tall tree for a gathering-place, as there was no house in the village with a roof large or sunny enough to suit their needs. It would have been interesting to have followed these birds when they left, and to track them and other companies on their eastward journey; but this I was not able to do, as I had to return to Oxford on the 18th.

But on the 6th of October, just before the Oxford term began, I was able to pay a hurried visit to some friends at Swanage, some fifteen miles east of Lulworth, on the coast of Dorset. I hardly hoped to see anything of migration, as it was so late; but on the morning of the 7th I walked to the rocky coast south-west of the little town. What I saw then, and on the following Tuesday, will be better understood by the reader if he will look for a moment at any map of this part of the coast—unless, that is, he happens to be personally acquainted with it.

From Weymouth, until just before it reaches Swanage, the coast runs in a fairly straight line from west to east, only bulging southwards somewhat about St. Aldhelm's Head; but at Durlstone Point, a mile from Swanage, it suddenly turns sharp to the north for many miles to Poole Harbour, where once more it starts eastwards, past Bournemouth and Lymington, to Southampton Water. Swanage, therefore, looks direct *east* over the sea, and is immediately opposite to the Isle of Wight, the white cliffs near the Needles being a very conspicuous object on any tolerably clear day, though separated from the gazer by some twenty miles of sea.

When, on the morning of October 7th, I reached the coast near Durlstone Point, I found that the Swallow-migration was still going on, for a small party soon passed me and disappeared towards that headland. As they vanished, the question occurred to me, what will they do when they reach the point where the coast turns northwards at a sharp right-angle? Will they follow it northwards, or will they cross the sea to the Isle of Wight, or is this, perhaps, a point at which they strike across to France? It began, in fact, to dawn upon me that this sudden turn in the coast-line was one which would surely raise a question in the minds of the birds as well as in mine, and I was extremely curious to see what they would do.

The question was soon answered. Walking nearer to Durlstone Point I watched for another party, which was not long in coming. They passed by me, and, as they neared the headland, rose in the air, higher and higher, not seeming to move onwards for a while, but simply circling round and rising, and then, at a great height, they set off over the sea in the direction of the Isle of Wight. I followed them with the glass till they were such tiny specks that it was painful to try and keep them in view. *The cliffs of the island were at this time very distinctly visible.* I watched one or two more parties follow in the same track; but I was not alone and could not stay long—my kind host was with me, and friendship forbade that I should weary him. It was not until the morning of the 9th, that I was at liberty to spend an hour or two in the same spot *in solitude*; and solitude, according to my experience, is almost essential to that patient watching which some of my Oxford friends call "taking the auspices."

As I left the house that morning, the hills were hidden in a soft mist, nor could I see anything of the Isle of Wight; it did not occur to me however at the moment that this might have some effect on the course taken by the birds. I was consequently rather taken by surprise, when I reached the cliffs about a mile west of Durlstone, and watched the first party that passed me, to find that instead of rising in the air and going out to sea, they turned back when they came near the headland, and still skimming close to the ground, and passing close to me as I sat sheltered from the wind under a wall, they made northwards over the hill towards the town of Swanage. After waiting a while, I saw another party take exactly the same course. They refused the sea-passage, and turned inland and northwards. The nature of the ground I was on prevented my watching them in this direction to any distance, and I could only stand there and wish that some kind wizard would turn me into a Swallow for but one hour, that I might follow in their track, and learn something of the ways and the minds of these little travellers. But it was a fair guess, that having refused the sea once, they would hug the land for some distance at least.

The sun had now come out, and I sat down to enjoy it while waiting for a third company of Swallows. All the birds I saw that morning, I may say, were Swallows, not Martins; and all of which I had a good view were young birds, so far as I could judge by their tails. Presently another series of ghostly little forms came gliding over me, and I at once jumped up and kept the binocular steadily on

them as they went eastwards. But this company did not return inland as the others had done ; like the party I had watched two days before, they rose in the air when they neared the point, and circling higher and ever higher, as if observing and considering, they at length began to disappear over the sea. I scrambled over a high loose stone wall, at the risk of breaking my bones, in order to reach a higher point and keep them longer in sight ; and then it was that I discovered that the *Isle of Wight had arisen out of the mist since I last was within view of it.*

I shall refrain from commenting on these facts, and from any hasty conclusions that might be based on them as to the mental operations by which these birds conduct their travel, till I have tried to see more at the same place next autumn. But I think I have told a story which may possibly induce others to help me in my observations, whether they live in the Midlands or on the coast. Wherever they may be, they will probably see something worth noting, if they watch all Swallows and Martins any time in early autumn.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.

(*Continued from page 77.*)

Some curious results have been obtained in experiments upon the effects of various substances in stopping the growth of Bacteria. It is well known how difficult it is sometimes to get the larger species of Fungi to develop, and the same thing is true of the smaller kinds in a still higher degree. One of the most striking instances is found in the account which Raulin gives of *Aspergillus niger* ; this is not indeed one of the Schizomycetes, but it is a pathogenic fungus, and in some respects similar to them.

To obtain the maximum growth no less than a dozen substances were needed : water, sugar, tartaric acid, nitrate and phosphate of ammonia, carbonates of potash and of magnesia, sulphates of zinc, iron, and ammonia, and silicate of potassium, all in constant and fixed proportions; the growth must also be maintained at a temperature of 35°C. and an abundance of moist air must have free access. The sulphate of zinc, *e.g.*, enters into this medium in only infinitesimal proportion, but if it were not present the fungus grew poor and died. On the other hand, the addition of an infinitesimal

proportion of nitrate of silver, viz., 1-1,600,000th part, abruptly stopped its growth and killed it. The growth could not even commence in a silver vessel. Equally fatal were one part in 500,000 of corrosive sublimate, one in 8,000 of bichloride of platinum, and one in 240 of sulphate of copper.

Another observer, Duclaux, sowed the spores of the Aspergillus on the same liquid nourishing material, in the one case with, and in the other case without, the tartaric acid; on the first a good crop arose in three days; on the other there was no growth. But, on the other hand, the liquid which contained the tartaric acid remained limpid and pure; no Bacteria developed in it: the second was turbid with the enormous numbers of Bacteria that crowded it. Add but a drop of tartaric acid to the second liquid, and the scene changes as by magic; the spores of the Aspergillus which have hitherto remained dormant begin to grow, soon take the upper hand, and produce as good a crop as in the other.

The true Bacteria are influenced almost as easily by the character of the circumstances in which they exist. They feed upon the substances that surround them, appropriating some of the elements themselves, and setting free the others to enter into new combinations. The result of their action is in the main akin to that which is called fermentation. In fact, Duclaux defines fermentation as "chemical transformations which dissolved substances undergo, under the influence of organisms, always devoid of chlorophyll, which develop and live in the interior of the liquid which is fermenting."

To show the kind of change which Bacteria can work we may instance the transformation of sugar into lactic acid, of lactic acid into butyric acid, of alcohol into acetic acid, of urea into carbonate of ammonia, of ammonia into nitrates, and of albumen into peptones. There can be no doubt that some of them play a very important part in the process of digestion, especially in the stomachs of herbivorous animals. Others produce colouring matters, red, blue, green, yellow, purple, pink, violet, brown, and, in fact, every possible colour; it is also believed that a microbe is the active agent in the production of indigo.

Putrefaction is now known to be but the result of many simultaneous and diverse fermentations, which go on in the decaying substance under the influence of Bacteria and a few other simple organisms. The most important fermentation is that which the Bacteria are capable of producing in complex organic nitrogenous compounds. If a substance, highly putrescible under ordinary circumstances, be sterilised

and preserved from the access of germs from outside, it will remain for ever almost absolutely unchanged, except for the loss of any volatile constituents. It will not decay, but the presence of a single Bacterian germ is sufficient to set up putrescence. The Bacteria do not all work simultaneously at this operation, but certain species appear successively, *Bacterium termo* being the first. Any proteinaceous substance, exposed to the air, is soon attacked by myriads of this species, but after a time they nearly disappear or diminish greatly in numbers, and their place is taken by other Bacteria, and by the Spirilla, or, as they are frequently termed, Vibrios. These, again, are succeeded by Monads, until finally the putrescible material is exhausted. Each organism lives by appropriating to itself the elements that it needs, and it seems that it leaves what it does not want in a condition to afford suitable pabulum for another species. The action is in general a molecular one, although it is possible that, in the case of the larger monads, the action may be partially mechanical, as stated by Dr. Dallinger. The ultimate result is to reduce the complex organic substance with which we started to its elements or to simple compounds, which are then free to unite again, and form parts of other organisms, perhaps higher in the scale of being. It is thus that life is rendered continuously possible on this earth.

The Great Advance.

The development of the Science of Bacteriology within the last decade is one of the most remarkable instances of the unexpected that can be found within the whole range of human knowledge. When we read of the state of this science ten years ago, how few species were then known, how little had been discovered about them, what enormous difficulties were found in doing more than merely observe and measure those species which were accidentally met with; when we remember the useless and unproductive controversies which raged about their specific value, their growth and development, and the questions of their spontaneous generation, and their connection with disease (controversies which were useless because sufficient data had not then been accumulated on which to found trustworthy conclusions), and when we contrast that state of darkness and confusion with the ease and certainty with which a Bacteriologist of the present day isolates, propagates, examines, experiments upon, and otherwise marshals and directs the almost invisible units of the armies with which he deals, we must confess that the

transformation offers one of the most surprising spectacles we can imagine of the great results arising from a single step.

That step in advance was the publication, in 1881, of Koch's discovery of the method of cultivating Bacteria upon solid nutrient gelatine. Let us consider for a moment the effect of this discovery, and the further steps which it renders practicable, or even easy, where previously an apparently insoluble difficulty had barred the way. In a natural state many kinds of Bacteria almost invariably occur together; even in cases where we may in all probability hope to get but one species, as for instance in the blood of a person who has died from some specific disease induced by a species of Bacteria (what is now called a *bacterian* disease), even then doubts are not prevented. We may get over all the difficulties of excluding other germs from our flasks, our nutrient solutions, our lancets, and our needles; we may use but a minute drop of the blood to be investigated; but after all, if two forms of Bacteria ultimately make their appearance in the liquid we are using, we have no guarantee that they came from the same original germ. Or again, when we take a drop of the solution, and with it inoculate an animal, if any disease makes its appearance in consequence, we can have no certainty to what the disease is to be attributed, since we cannot tell that there may not have been a species in the liquid that was used equally efficacious (or more so) in producing the observed result, as that which we intended to introduce.

But when the solid stratum is used and Koch's method followed, all this uncertainty becomes the plainest and most entrancing certainty. When we have obtained, by diluting with sterilised water, a drop of fluid in which the bacterial germs are few in number, we inoculate with this minute drop a few cubic centimetres of liquefied nutrient gelatine, mix the whole well together, and then spread it out in a thin layer upon a plate of glass. When it becomes solid, each germ will almost inevitably be isolated from its neighbours and, provided that the species is capable of growing in the substance and at the temperature we are using, each will proceed to divide and redivide in its own characteristic manner, and form, in a few hours or days, a little colony visible to the naked eye. If the dilution of the germs has been carried to a sufficient extent, each of these colonies will be at first distinct from the others which grow in its neighbourhood. By observing the stages of their growth under a low power of the microscope, and rejecting all that are irregular or

confluent with other colonies, we shall be quite sure that a minute particle, taken from one of these colonies, contains the products of only a single germ. That this assumption is justified by the facts can easily be shown. It is possible in this way to take any given species that will thrive under the conditions, and propagate it successively from plate to plate for any number of generations, always maintaining the same character (or the same combination of characters) both in the macroscopic and in the microscopic aspects of the colonies. There cannot remain the slightest loophole for doubt that we have obtained the required species "pure" and free from all admixture; moreover, we are able to rebut another objection that was frequently made to the old experiments, namely, that the cause of death where an animal was inoculated with Bacteria was not the organism itself, but some chemical substance which accompanied it. For, since the chemical substance being inorganic would be incapable of increase, while the Bacterium would multiply itself to any extent required, it is obvious that the ultimate result, after many successive cultivations, would be the entire elimination of the hypothetical chemical compound, and the production of a material in which the only element present, except the nutrient medium, was the organism under investigation.

It is of course necessary that, in all the manipulations required, precautions should be taken to exclude all foreign germs, but the methods of *sterilising* (as it is called) everything that is used—gelatine, flasks, plates, needles, etc.—by means of heat or steam or acid, are now so well understood and so successful, that no danger need be feared on this score. Moreover, we can use that principle, which is now so widely and so constantly employed, of a "control" experiment. For if we go through exactly the same manipulations with two portions of the material, but sow germs on the one but not on the other, and if we invariably see the one on which nothing was sown remain unchanged, while the other reproduces the organism with which we are experimenting, then we are entitled to conclude that our precautions for the exclusion of foreign germs have been entirely satisfactory. We are now in a position to investigate the morphology and biology of these minute organisms with the same certainty with which we can experiment with the seeds of Phanerogams.

One of the most curious practical applications of this principle of "pure" cultures is found, not indeed among the Bacteria, but in a group closely allied to them. One of the chief functions of Bacteria in the world is that of inducing fermentation; and their rôle in this respect is shared by the

Yeast-Fungi or Saccharomycetes. The various species of yeast can be cultivated like the species of Bacteria, in a modified form of plate cultivation. But the chief point to which your attention is directed is, that the object of the process in this case is a purely commercial one, or in other words it brings in money. English breweries often suffer from fluctuations in the quality and flavour of their beer. This arises from the fact that no yeast in ordinary use is pure; they all contain more than one kind of Saccharomycetes, as well as many kinds of Bacteria. The latter are really impurities, which sometimes increase so much in number that the yeast ceases to be of any value for the purposes of brewing.

This "degeneration," as it is called, has long been known to practical brewers, but being totally ignorant of the microscope, or even of the existence of Bacteria, they attributed the cause of it to all sorts of influences but the right one. The failure of the beer was assigned to the malt. the water, the hops, the temperature of the wort, etc., etc., and no two specialists in brewing could ever agree entirely as to what it was that caused the degeneration in any given case. Still they had invented a practical remedy for this state of things, which consisted in the periodic interchange of yeast between breweries in different localities. This interchange sometimes succeeded in renovating the yeast, and giving it a new lease of life. But it was always subject to risks, and when one obtained an "exchange" it was never possible to foresee whether it would be successful.

The cause of this difficulty obviously lies in the impurities which contaminate the yeast. Now by taking a small sample of good yeast, and diluting it largely with sterilised water, it is found that a tiny drop of the liquid taken up on the end of a glass rod, contains only a small number of yeast cells. This drop is introduced into a sterilised flask containing about 10 cubic centimetres of sterilised gelatinous wort—that is, ordinary brewers' wort mixed with gelatine. This gelatinised wort being melted and shaken, a small drop is spread evenly upon a microscopic cover-glass, and allowed to solidify; it is then placed over a moist cell on a microscopic slide, and kept at a temperature of 25°C. in an incubator. Each cell entrapped in the gelatine is watched beneath the microscope as it develops into a colony by budding, and every care is taken that any case where two colonies may have coalesced should be rejected. We can now select any pure colony, and transfer it to another similar flask. By removing the beer that is

formed and adding fresh sterilised wort, it is obviously possible to obtain a goodly supply of yeast. Finally this is transferred to a large apparatus where sterilised wort can be supplied in any quantity, and the pure yeast derived from a single cell is thus continually produced and drawn off as required for use. Throughout every operation, the precautions dictated by previous experience are taken to exclude the germs of "wild" yeast or of Bacteria. This process, invented by Dr. Hansen, a Continental brewers' microscopist, is now no longer an experiment. It is worked on a large scale in several breweries, with the most brilliant and commercially successful results. In these establishments "returns" are unknown; bottled beer leaves no sediment, and any desired flavour can be secured and maintained the whole year round.

(To be continued.)

THE WORK OF FIELD CLUBS.*

BY CH. CALLAWAY, D.SC., F.G.S.

In accepting the presidency of this Club, my desire was to promote amongst its members an interest in Nature. The Severn Valley abounds with specimens of her handiwork. Each creature that swims in the waters of our noble river, each flower that blooms on its banks, each hill that looks out over its verdant meadows, is a microcosm of wonders; and as the prophet beheld horses of fire and chariots of fire where the common eye saw nothing, so the true student of nature expatiates in a world of beauty and marvel which is invisible to the untrained sense. A Newton perceives laws where other men had seen only aimless motions. To a Darwin, a buttercup is a wonder whose glory derives a tenfold charm from the mysteries which still lie hidden in its nectaries or its carpels, but to most men it is a buttercup and nothing more. Surely it is worth making an effort to penetrate the secrets which hide themselves in the common objects that lie about us.

But I may be met by the objection that it requires a long course of study to fit the mind to look into Nature. This is by no means the case. Training is no doubt required—except perhaps by a Darwin—to qualify men to make important discoveries, but we must be content at first to learn what

* Presidential Address to the Severn Valley Field Club, delivered at Wellington, January 24th, 1889.

is already known, and this we can do without special qualifications. Unhappily, our schoolmasters have hardly yet begun to perceive that the great book of Nature—the stars, the mountains, the worlds of plant and animal life—is of more real interest and importance to living men than the correct scanning of Greek iambics, or the enunciation of the fact that the nearest distance between two points is a straight line. I am far from depreciating classics and mathematics. They have their place in a liberal education, but they have no right to supremacy, and I venture to affirm that a school, whether public or private, which does not teach natural science, is omitting that kind of instruction which is best adapted to give to the minds of its alumni solidity, breadth, and insight.

The esteemed President of the Caradoc Field Club, the Rev. J. D. La Touche, is attempting to promote original research in natural history amongst the members of his club. The object is most commendable, and in the Caradoc Field Club there are more men of sufficient competence to respond to his wishes than this club can supply, and for the present we must content ourselves with more modest work. Nevertheless, there are many fields of work in which we may acquire an intelligent knowledge of broad facts, or may even open up new veins of enquiry. Those who are interested in plants would find a world of marvels in the fertilisation of flowers. Mr. Darwin has shown that the vigour of plants largely depends upon the fertilisation of their ovaries by pollen from other plants of the same species. This pollen is usually conveyed by insects. Thus it is the interest, if we may so speak, of each plant that it shall be visited by as many insects as possible. Hence the numerous devices by which plants attract their visitors. The little tube with its store of honey is the chief allurement to the insect, but the perfume, the colour, the shape, of the flower are all concerned in facilitating the process of fertilisation ; so that it is not too much to say that the wonderful beauty and variety of flowers have resulted from the need of cross-fertilisation. Every garden, every hedgerow, will provide us with abundant material for enquiry. Why has the rose separate petals, while in the primrose the petals are combined into a tube ? Why is the flower of the pea irregular, while the corolla of the convolvulus is as regular as a funnel ? These and ten thousand similar enquiries would stimulate the faculties and might lead to the discovery of new facts. The mere collection of specimens is, of course, a good training for the eye, and it tends to promote habits of accurate thought ; but to search

into the causes of things is the chief aim of science ; it is thus that we reach that inner laboratory of the universe where some knowledge may be gained of the actual working of her majestic laws.

But I pass on to that science of which I can speak with more familiarity. The geology of our county is probably unrivalled for the variety and interest of its phenomena. It attracts scientific men from all parts of the civilised world. A year rarely passes without visits from eminent strangers. It is to the great loss of Shropshire men and women if they remain in ignorance of the remarkable phenomena amidst which they live. Many, no doubt, are withheld from taking up the study by the difficulty of making a start. They are afraid that if they were to plunge *in medias res* they would be quickly overwhelmed with perplexities and discouragements. But the difficulties may not be so great as they anticipate. To rush at once into problems fit only for an advanced student would be unwise, but there are shallows in which they may paddle before they strike out for the deeper questions.

There are two ways in which we may approach the study of geology. Some thirty years ago I commenced to collect fossils, and this is, perhaps, the most frequent method of acquiring an interest in the science. At first, the fossils are mere curiosities ; they are what stamps are to boys. But, after a time, we pass from the symbol to the meaning that underlies it ; we are led to study the wonderful pages which record the history of successive dynasties of plants and animals ; we learn how type after type has come into being, and, after giving rise to higher forms, has passed away ; how each type has foreshadowed with ever-increasing distinctness the highest type of all, man ; and how the law of progress from lower to higher forms in the inferior creation seems to prophesy hopeful things for the future of the human race.

But we may approach the study of geology from another side, the artistic or æsthetic. The dullest eye can see that our Shropshire scenery is beautiful. It needs no Ruskin to point out to us the graceful lines of Wenlock Edge, the elegant curves of the Wrekin, the serpentine meanderings of the Severn. But there is a meaning in every line of the landscape. Our mountains owe their form to the hand of the cunning sculptor, Nature, chipping, grinding, polishing, without pause or loss of skill, for countless ages. Compare together the semi-lunar ridges of the Wrekin or Caer Caradoc, the sharp straight line of Wenlock Edge, the hog's-back elevations of the Longmynd, the serrated outline of the Stiper Stones, the tabular summit of the Titterstone Clee,

the triple diadem of the Breiddens. Geology can tell you how these mountains have assumed their form. Why, at one spot, does the Severn wind about in loop-shaped curves, while in another it cuts straight through a mighty wall of limestone? Geology can answer your questions. North Shropshire is a plain diversified by a few low elevations, while South Shropshire rises into numerous mountain peaks and ridges. There are reasons for the differences, and geology can give them. But these are only a few of the problems which lie around us. The history of the humblest hill that rises above the Severn Valley opens up questions of profound interest. The very sand heap, from which we cart the materials for our garden soil, tells us of the time when the Wrekin stood as an island amidst the waters of an archipelago, and the ice-floes from the North scattered their stony burdens over what is now the plain of Shropshire. The red gravel with which we pave our walks in Wellington takes us back to an epoch inconceivably more remote, more ancient even than the period when the Archæan volcanoes of Shropshire poured forth their lavas, probably to the time when no plant or animal had come into being on the earth. Every stone in a wall, unless it be a brick or a piece of slag, has a history infinitely more ancient than that of Egypt or Babylonia; every slate on our roofs takes us back almost to the advent of life on our globe. To the geologist, there is meaning in the very dust. Believe me that the study of the stones is not so difficult and dry as is commonly supposed. To associate an earnest enquiry into Nature with the less serious pleasures of our club meetings will give them purpose and dignity. To the lighter music of the Fauns and the Dryads let us add the lofty chords of Apollo's lyre. Though the members of this club may meditate the sylvan muse "*sub tegmine fagi*," there is no reason why they should do it "*tenui avenâ*."

WILD BEES.*

BY R. C. L. PERKINS,

JESUS COLLEGE, OXFORD.

Bees constitute a portion of the very extensive order *Hymenoptera*, and, together with the ruby wasps (*Chrysididæ*), ants (*Heterogyna*), *Fossores*, and true wasps (*Vespidæ*), form that division which is termed the *Aculeata*. They themselves

* Read before the Oxford Natural History Society, February 19th, 1889.

form a very well-marked and distinct group, the *Anthophila*. which in this country consists of about two hundred species. According to their habits we may divide them into the "solitary" species and the "social," the latter division, excluding the hive bee, consisting only of the *Bombi* or humble bees. The solitary species excavate cylindrical burrows in the soil, in wood (decayed or sound). and various other substances. The cells formed within these, wherein the food for the larvæ is stored, in the simplest cases (*Andrena*, &c.) consist merely of a portion of the burrow with the sides very carefully smoothed by the insect's tongue ; or they may be plastered with several coatings of a secretion which dries quickly and forms a very delicate and glittering lining (*Colletes*) ; or they may be formed of pieces cut from various kinds of leaves, which keep the larval food from contact with the sides of the burrow ; and sometimes within the leafy walls there may be a lining cut from the brilliant scarlet or pink petals of the garden geraniums (*Megachile*). Another of our bees (*Anthidium*) encloses its cells in a soft downy covering composed of the hairs of the stems and leaves of *Stachys* and other plants which it scrapes off with its mandibles.

The burrows may be simple tubes, and the cells placed one above the other, with partitions formed between each ; or short lateral tubes may be found in communication with the main tube, and usually at the blind end of each of the lateral branches is one single cell. Each cell contains a little, rounded mass of pollen, its size proportional to the species by which it is stored, and it is moistened with a greater or less amount of honey.

Two or more individuals never co-operate either in forming or in supplying the cells, but each is quite independent of its neighbour, and keeps to its own burrow when once it has entered upon the task of providing for its young. On the other hand, the social species (*Bombus*) form communities, the members of which mutually assist one another in building their nest and attending to the young brood.

All bees, however, do not gather food for their young: a number of genera are parasitic, and these enter the burrow or nest of the industrial kinds and deposit their egg within, on the pollen which the industrial bees have gathered.

It is necessary in considering the habits of our wild bees to examine a few of the more important structural characters. In most cases the pollen is collected on the hind legs, especially on the joint called the *tibia*. The apparatus for this purpose is not the same in the solitary species as in social ones ; in the former the *tibiæ* are covered, especially outwardly,

with a dense clothing of hairs, which is known as the *scopa* or pollen brush, and in some genera, *Anthophora* for example, this covering is continued over the basal joint of the *tarsi* as well.

In the social bees the hairs on the *tibiæ* are so arranged as to form a kind of basket in which the moistened pollen is carried, and this structure is known as the *corbiculum*. The *tibiæ* themselves on their external surface, are smooth and slightly concave, the curved stiff hairs being set along the margins.

The parasitic species have no apparatus for collecting pollen, and a few industrial genera, *Prosopis* and *Ceratina* for instance, have the same deficiency, or at least are but ill adapted for the purpose; the bees belonging to these two genera store up a semi-liquid honey in place of the usual pollen mass.

But it is not on the *tibiæ* alone that there is a special arrangement for gathering pollen. In some bees a pollen-brush is situated on the terminal abdominal segments beneath, and it is noticeable that these have the most highly developed instincts and the most interesting habits of all our British species. These, then, are the most important structures for pollen gathering, but many other parts assist in the work. The long "*floccus*" on the trochanter of *Andrena*, and the thoracic hairs may be mentioned, especially those on the sides of the metathorax, which in some species are very long and curved, and beautifully plumose, as in *Andrena dorsata* for instance, and which are often loaded with pollen. Indeed, some species cover themselves so entirely as to be hardly recognisable, particularly those which frequent the blossoms of *Hieracium* and other yellow *Compositæ*. *Andrena humilis* is a remarkable instance of this, for hundreds of these bees may be seen on a fine day round a populous colony, each one appearing entirely yellow from the covering of pollen collected from the hawk weeds.

Every one knows how important insects are for the fertilisation of flowers; and bees, since their food is entirely obtained from this source, are the most important agents in this work, and in general are the best adapted for it, because of their hairy exterior and the peculiar character of these hairs. Certainly, though bees are greatly indebted to flowering plants, the latter derive the greatest benefit from the visit of bees, and I imagine that a bee can rarely visit a flower without effecting that object, which the plant, by the attractions it offers, has striven to attain. One must also take into account the methodical habits of bees in visiting one kind of flower at a time, and not first one species and then

another. In this respect they seem to surpass all other groups of insects.

Some of our species, indeed, appear to restrict their visits entirely to one species of flower. *Andrena florea* appears to visit only the blossoms of the briony *(Bryonia dioica)*, and two other species of this genus (*A. Hattorfiana* and *Cetii*) are only found on the common Scabious *(Scabiosa arvensis)*. Moreover, a very large number of our bees, though they visit different flowers in different localities, yet confine their attention to one species in any one locality; and though some species of bees visit a considerable number of different flowers, yet *the individuals* of these species, only in very rare instances, visit first one kind of flower and then another.

All bees have, on some parts at least, branched or feathery hairs, amongst which the pollen grains are readily caught, and these are the most common kind of all.

Another very common form of hair, is marked by a spiral thickening, and is found more or less numerously in the pollen-brushes on the *tibiæ*, and it is of this kind of hair that the ventral pollen-brushes are composed. On the *tarsi* may be found broad, flat hairs, or hairs with dilated and flattened *apices*, for removing the pollen which adheres to the body.

The only other structure which I need refer to is the tongue. In its least developed (*Colletes* and *Prosopis*) form in bees, it closely resembles that of the wasp, as one would expect from the fact that the bees follow next after the wasps in the natural order: in these it is short, broad, and bilobed at the apex. In the genera *Anthophora* and *Bombus* it reaches its greatest development, so that some of these species are enabled to obtain the nectar from the honeysuckle and other flowers which no other of our bees can reach. Between the long slender organ of these two genera and the short wasp-like tongue of *Colletes* is a long series of intermediate stages in development.

Turning now to the enemies of bees, a few may be noticed here which are more or less indiscriminate in their attacks. Others which are only obnoxious to the genera I have selected for this paper, or are more obnoxious to these than any other, will be discussed under those genera.

To pass over the insectivorous birds and other vertebrates, some of which destroy a considerable number of these insects, there is one enemy from the attacks of which few of our wild bees are altogether exempt.

I am alluding to the *Forficulæ*, commonly called earwigs, and the destruction they cause of such species as form colonies can hardly be estimated. Last year, for instance,

these creatures were more than usually abundant, so that I was able to fully realise the extent of their attacks on several colonies of a species of *Halictus* (*H. rubicundus*, *Chr.*). These bees emerge in August, and the females hibernate, laying their eggs in spring and early summer. In August I examined hundreds of burrows of *H. rubicundus*, which at this time should have contained pupæ and freshly-emerged bees, but not one was to be seen. There were still a few old and battered specimens of the previous year, and many more dead and attacked by mould. This much was due to the weather, but in all such cells as had been stored, instead of pupæ or bees, there were *Forficulæ*, and here and there a fragment of pollen not as yet quite devoured. Larvæ, pupæ, young bees, and pollen all disappear before these destroyers, while the burrows afford them a secure retreat; and when they have demolished the contents of one cell they crawl on to the next and do the same.

Spiders, too, devour large numbers of bees. Most entomologists must have noticed the species which lurk in or on flowers, and how beautifully many of them assimilate with the colour of the part on which they remain motionless: daisies, buttercups, mallows, and *Hieracium*, &c., are much frequented by them. When a bee (or in fact any insect) alights the spider springs on it, and either devours it on the flower or drops to the ground and carries it off. Species as large as the larger *Andrenæ* are captured in this way by spiders of comparatively small size. The Fossor *Philanthus* also carries off bees bodily to provision its cells, while ants will carry off the smaller species as they alight at their burrows. Other *Fossores* also occasionally carry them off for a similar purpose. Parasitic *Diptera* may often be seen cautiously entering when the bee is abroad, in order that they may deposit their eggs, and the larvæ proceeding from these devour the larvæ of the bee. The same is true of various species of *Coleoptera*.

(To be continued.)

FORAMINIFERA OF OBAN, SCOTLAND.

BY E. W. BURGESS.

(Continued from page 81.)

21. *Textularia gramen.* D'Orbigny, 1846.
    Balkwill and Wright (I. F.), 1885, p. 332, pl. xiii., figs. 13-4.

Balkwill and Millett (G.), 1884, p. 17.
A short broad, textularian form. Common.

22. *Gaudryina filiformis.* Berthelin, 1880.
Wright, J., Proc. Bel. Nat. Field Club (1880-1). Appendix, p. 180, pl. viii., figs. 3, 3A, 3B.
Balkwill and Millett (G.), 1884, p. 7.
Robertson, D., Portree Bay, abundant.
J. Wright says: "An elongated sandy *Gaudryina*, with later chambers sub-quadrate; often in a fragmentary state, the loose sandy texture of its test making it liable to be easily broken." Rather rare.

23. *Verneuilina polystropha.* Reuss, 1845.
Williamson (R. F.), 1858, p. 65, pl. v., figs. 136-7.
Balkwill and Millett (G.), 1884, p. 7.
Robertson, D. (W. S.), 1874, common.
An arenaceous form (Bulimina), varying in texture, generally of an orange or brown colour.
Very common.

24. *Bulimina pupoides.* D'Orbigny, 1846.
Williamson (R. F.), 1858, p. 62, pl. v., figs. 124-5.
Robertson, D. (W. S.), 1874, frequent.
An indistinct spiral form of numerous well-developed segments. Frequent.

25. *Bulimina marginata.* D'Orbigny, 1846.
Williamson (R. F.), 1858, p. 62, pl. v., figs. 126-7.
Robertson, D. (W. S.), 1874, common.
An easily recognised form, sometimes very short, often elongated; the convolutions either serrated or crenulated on the smaller edge. Common.

26. *Virgulina Schreibersii.* Czjzek, 1847.
Williamson (R. F.), 1858, p. 63, pl. xiii., figs. 18-21.
Robertson, D. (W. S.), 1874, frequent.
The segments are longer and fewer than in the *Buliminas*, and of a textularian character.
Frequent.

27. *Bolivina punctata.* D'Orbigny, 1839.
Brady, H. B., 1864, Trans. Linn. Soc., London. Vol. xxiv., p. 468, pl. xlviii., fig. 9.
Robertson, D. (W. S.), rare.
A slender textularian form, often twisted. Frequent.

28. *Bolivina plicata.* D'Orbigny, 1839.
Brady, H. B., Ann. and Mag. Nat. Hist., Ser. 4, Vol. vi., p. 302, pl. xii., figs. 7A-B.
Robertson, D. (W. S.), 1874, rare.

This textularian form has four rows of longitudinal markings on the test, involved or plaited, the angle of one side in the curve of the other.
Very common.

29. *Bolivina difformis.* Williamson, 1858.
Williamson (R. F.), 1858, p. 77, pl. v., figs. 166-7.
Brady, H. B., 1884. Challenger report, p. 421, pl. liii., figs. 5-6.
Balkwill and Wright (I. F.), 1885, p. 335.
As Messrs. Balkwill and Wright observe: "A true *Bolivina*, having the longitudinal, notch-like aperture, common to all the *Bolivinæ*." H. B. Brady remarks: "If so, the *Bolivina pygmæa*, Challenger Report, may be merged into the same species." Rare.

30. *Bolivina dilatata.* Reuss, 1849.
Williamson (R. F.), 1858, p. 76, pl. vi., figs. 164-5.
Robertson, D., Portree Bay, 1880.
A much broader form than the former ones, with a very acute edge. Frequent.

31. *Cassidulina lævigata.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 68, pl. vi., figs. 141-2.
Outline very circular, form lenticular or biconvex.
Rare.

32. *Lagena globosa.* Montagu, 1803.
Williamson (R. F.), 1858, p. 8, pl. i., figs. 15-6.
Balkwill and Wright (I. F.), 1885, p. 336.
Robertson, D. (W. S.), 1874, frequent.
Mr. J. Wright draws attention to the globular Lagenæ, "the apertures of which are respectively stellate and fissurine," and restricts the stellate aperture to *L. globosa*, the fissurine aperture to a round form of *L. lævigata*, Reuss. Frequent.

33. *Lagena lævis* var. *clavata.* D'Orbigny, 1846.
Williamson (R. F.), 1858, p. 5, pl. i., fig. 6.
Balkwill and Millett (G.), 1884, p. 10.
Fusiform in shape, with long neck, and, as J. Wright points out, a milled rim at the aperture.
Frequent.

34. *Lagena gracillima.* Seguenza, 1862.
Robertson, D. (W. S.), 1874, common.
A more lanceolate form than the last, both ends acuminate. Frequent.

35. *Lagena sulcata.* Walker and Jacob, 1798.
Williamson (R. F.), 1885, p. 5, pl. i., fig. 8; p. 6, pl. i., fig. 10; p. 7. pl. i., fig. 11.

Balkwill and Millett (G.), 1884, p. 9.
Balkwill and Wright (I. F.), 1885, p. 338, pl. xiv., figs. 1-2.
Wright, J. Recent Foraminifera, Down and Antrim, p. 103, pl. iv., fig. 10. Proc. Bel. Nat. Field Club. Appendix, 1876-7.
Robertson, D. (W. S.), 1874, common.
Oban, 1883. Frequent.

36. *Lagena Williamsoni.* Alcock, 1865.
Alcock, 1865. Proc. Lit. and Phil. Soc., Manchester. Vol. iv., p. 195.
Mr. J. Wright, 1877. Proc. Bel. Nat. Field Club, 1876-7. Appendix, p. 103, pl. iv., figs. 11-13.
Balkwill and Wright (I. F.), 1885, p. 339, pl. xiv., figs. 6-8.
A well-marked form, the lower part of the neck distinctly ornamented with hexagonal reticulations. Common.

37. *Lagena striata.* D'Orbigny, 1839.
Williamson (R. F.), 1858, p. 7, pl. i., fig. 14.
Balkwill and Wright (I. F.), 1885, p. 337.
Robertson, D. (W. S.), 1874, common.
Mr. J. Wright remarks that there are two well-marked forms of this species, one elongate, with very delicate longitudinal striæ, the other larger, more globular.
There is an exceedingly great variety of form and size of striæ, in both the *L. striata* and *L. semi-striata.* Common.

39. *Lagena gracilis.* Williamson, 1848.
Williamson, 1848. Ann. and Mag. Nat. Hist., Ser. 2, Vol. i., p. 13, pl. i., fig. 5.
Williamson (R. F.), 1858, p. 7, pl. i., figs. 12-3.
Appears to be a finely striated variation of *L. lævis.* Rare.

40. *Lagena squamosa.* Montagu, 1803.
Williamson (R. F.), 1858, p. 12, pl. i., fig. 29.
Balkwill and Wright (I. F.), 1885, p. 340, pl. xiv., fig. 9.
Robertson, D. (W. S.), 1874, frequent.
A lagena that varies very much in every way—in form, size, and also both in shape and arrangement of the areolæ. Frequent.

41. *Lagena hexagona.* Williamson, 1848.
Williamson, 1848. Ann. and Mag. Nat. Hist., Ser. 2, Vol. i., p. 20, pl. ii., fig. 23.
Williamson (R. F.), 1858, p. 13, pl. i., fig. 32, fig. 30.
Robertson, D. (W. S.), 1874, frequent.
A variety of *L. squamosa* in which the areolæ are regular hexagons. Rare.

42. *Lagena lævigata.* Reuss, 1849.
Robertson, D., 1883. Trans. Geol. Soc., Glasgow, Vol. vii., p. 24.
Balkwill and Millett (G.), 1884, p. 13, pl. ii., fig. 6.
Outline pyriform, rather narrower toward the fissurine aperture; compressed. Frequent.

43. *Lagena lævigata* var. *lucida.* Williamson, 1858.
Williamson (R. F.), 1858, p. 10, pl. i., fig. 22.
Balkwill and Millett (G.), 1884, p. 12, pl. ii., fig. 7.
Balkwill and Wright (I. F.), 1885, p. 340. Rare.

(To be continued.)

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

A meeting of the Committee of Management of the Midland Union was held on the 17th of April, at which the arrangements for the Annual Meeting in the summer were discussed. It was finally determined to make a change in the method of holding the Meetings, so as on the one hand to diminish the labour and also the pecuniary risk for the Society of the town where the Meeting is held, and on the other to make the programme more suitable to the wants of those members who can only spare one day to the Meeting, and of those who can attend the whole, as well as of those who coming from the longer distances yet do not wish to give up the whole of two days. It is therefore proposed that on the afternoon of the first day of the Meeting there shall be an opportunity for seeing the local objects of interest; that the business meetings shall take the place of the Conversazione in the evening, and that the Excursion or Excursions on the next day shall start at such an hour as shall permit of the members who live near taking part in them, and yet shall get back in time for the visitors to get away by evening trains.

It will be seen that the labour for the local Society is by this means reduced to the very small amount necessary to arrange an interesting route for an excursion and to order the vehicles.

It is intended to hold the first Meeting under this plan at Rugby, probably early in July, but the date will be finally determined a little later.

The subject of the Secretaryship of the Union was also discussed. Mr. Lawson Tait undertook the post of Honorary Secretary; while in order to relieve the present Secretary of the office, which he has for some time wished to resign, the Committee appointed (subject to his consent, which however has not yet been definitely given) a gentleman to act with him for this year, with the intention of after that taking the office altogether.

The Secretary was directed to request each Society in the Union to contribute at least one paper in the year to the "Midland Naturalist."

A list of gentlemen to be asked to act as adjudicators for the Darwin Medal was then drawn up.

Wayside Notes.

"The Middle Lias of Northamptonshire."—The interesting papers which have appeared under this title in the pages of this magazine have been collected and reprinted, with additions, in a compact volume, which is published by Messrs. Simpkin, Marshall and Co., London, price 3s. 6d. The subject is considered under the following heads:—(1) Stratigraphically, (2) Palæontologically, (3) Economically, (4) As a source of water supply, and (5) As a mitigator of floods. The author is Mr. Beeby Thompson, F.G.S., F.C.S., of Northampton.

Flora of Derbyshire.—The Rev. W. Hunt Painter, a well-known botanist, has issued a circular announcing the speedy publication of a Flora of Derbyshire on which he has been engaged for some years. It is intended to serve as a companion volume to "Cybele Britannica," the "Compendium" thereto, and other publications of the late Mr. H. C. Watson, as well as to the "Flora of the Lake District," by Mr. J. G. Baker, F.R.S., F.L.S. The book will contain an introductory chapter on the Geology of Derbyshire, and an account of its Botanical Bibliography. All the local critical genera have, we are informed, been submitted to botanists who have made a special study of them. A map of the county will be given. The price to subscribers will not exceed 5/6; after publication the price will be 7/6. Any of our readers who may desire to possess this book should send in their names, without delay, to the author, the Rev. W. H. Painter, Knypersley, Congleton. The Duke of Devonshire, Lord de Tabley, Professor C. C. Babington, Mr. J. G. Baker, and many other botanists of eminence have already given their names as subscribers.

A Travelling Naturalist.—It will, we think, interest our readers to know that Mr. E. W. Burgess, whose paper on the Oban Foraminifera is now appearing in these pages, is a member of the D'Oyly Carte Travelling Opera Company, recently performing at Birmingham, and that he has to seize his opportunities of studying Natural History during the intervals of his travels through the kingdom. Mr. Burgess

has made the Foraminifera and the Diatoms his special subjects; and, through the friends he has made in all parts of the country, he is enabled to have access to the various helps he needs in all the more important towns. But, out of London, he informs us, there is no town which offers to him such great advantages as Birmingham through its Natural History Society, and in the use of books, microscopes, &c. In Manchester, the Zoological Department of Owens College; in Edinburgh, the Laboratory of the Botanical Gardens and the Chambers Street Industrial Museum; in Glasgow, the Hunterian Museum and the Botanical Department of the University; in Dublin, the Museum and the Library of Trinity College; and in a few other places similar smaller institutions, whose resources are placed at his disposal by the kindness of officials and friends, have all assisted him in his studies; but none of them can be compared, for convenience and help in actual work, with the Birmingham Society's room. Mr. Burgess also says that he has found the Free Libraries in most large towns wonderfully useful.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Sociological Section, Feb. 18th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Stone read the eighteenth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Interpretation of Evolution." A lengthy discussion followed on the subject of nitrogenous compounds, it being contended that they form an exception to the law that motion is dissipated during integration as they produce cold during combination, and contain so much motion when combined.—Feb. 26th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Hughes was re-elected president, and Mr. Herbert Stone secretary for the ensuing year. Mr. Grove exhibited for Miss Gingell, of Dursley, *Ag. velutipes*, *Merulius Corium*, *Peziza coccinea*. Mr. Bagnall exhibited for Miss Gingell, *Eurhynchium crassinervium*, *Fissidens cristatus*, and *Galanthus nivalis* from near Dursley. Mr. Stone exhibited *Marsilea macropas*, the Nardoo plant, a Hepatic from Queensland. Mr. Grove read his paper on "Evolution in General," dealing with the five chapters of Mr. Spencer's "First Principles," XIII.—XVII., in which he expounded the law as it related to each phase of existence, the Inorganic, Organic, and Superorganic.—March 8th. Mr. Alfred Browett in the chair. The chairman called attention to the lecture recently delivered by Dr. Dallinger, at the Midland Institute, upon "Researches into the Infinitesimal, with their Bearings on Evolution." Also to a paragraph which appeared in the *Pall Mall Gazette* concerning the Section. Miss Goyne gave her exposition of the nineteenth chapter of Herbert Spencer's "First Principles," entitled the "Instability of the Homogeneous."—March 26th. Mr. W. B. Grove, M.A., in the chair. The president announced that Bennett and Murray's Handbook of Cryptogamic Botany had been presented to the Society. A vote of thanks to the donor was carried. Mr. Stone read, for Mr. Hughes, a letter which recently appeared in the *Pall Mall Gazette*, from Sir Philip Magnus, in reference to the formation of a Spencer Society in London. Mr. Bagnall exhibited *Fissidens bryoides* from Coombe Woods, Coventry, with microscopical preparation. For Miss Gingell, *Encalypta vulgaris*, *Polytrichum aloides* var. *minus*, and *Barbula aloides*, with microscopical preparation of same; all from Dursley, Gloucestershire. Mr. Stone exhibited, for

Mr. Hughes, four photographs of Cingalese plants of great beauty. The subjects were respectively: Fan Palms, Talipot Palms in flower; avenue of Cocos Palms in the Peradenyia Gardens, Kandy; and Giant Tree Ferns. These were received by Mr. Hughes from Mr. Councillor Clayton, from Ceylon. Mr. Bagnall read a long and interesting description of the photographs with an account of the uses of the plants. Mr. Grove exhibited *Œcidium lapsanæ*, the first of the season. Mr. Stone exhibited microscopic preparations of *Sphagnum cymbifolium*, found under nine feet of gravel at Small Heath. Also drawings of Cotyledons of Primula, including six abnormal forms. These were drawn from a batch of seedlings fourteen in number, eleven of which were more or less abnormal, varying in five different ways.—March 28th. Mr. A. Browett, F.G.S., in the chair. Mr. Colbran J. Wainwright gave his exposition of the twentieth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Multiplication of Effects." In his paper, which was of fifty minutes' duration, Mr. Wainwright discussed the subject in a very thorough and able manner, mainly in its connection with the previous one, "The Instability of the Homogeneous," and argued that if absolute homogeneity were perfectly stable, as stated by Mr. Spencer, then our reasoning must commence with heterogeneity of some kind in order that change may be assumed to take place; consequently it was unnecessary to assume that homogeneity of any kind was unstable, for, given heterogeneity of even the simplest character, the multiplication of effects was by itself sufficient cause for change. A long discussion, which was adjourned from the lateness of the hour, followed, in which the Chairman, Miss Byett, and Mr. Stone took part.—Biological Section, April 9th. Mr. Charles Pumphrey in the chair. Mr. J. E. Bagnall exhibited *Vaccinium intermedium*, and *Sphagnum cuspidatum* var. *plumosum*, both new to Warwickshire; also, for Miss Gingell, *Helleborus fœtidus*, and *Adoxa moschatellina*, from Dursley. Mr. Alfred Heneage Cocks, F.Z.S., of Great Marlow, then read a most interesting paper, illustrated by diagrams and specimens, "On the Fin-whale Fishery off the Lapland Coast."

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—March 18th. Mr. H. Hawkes exhibited *Docophorus atratus*, parasite of rook, also *Anguinaria anguina;* Mr. Dunn, *Nitella translucens.*—March 25th. Mr. Madison showed specimens of *Bulla cylindrica*, from Singapore; Mr. J. Moore, gizzard of black ant. Mr. A. Camm then read a paper—"Notes on Fungi." The writer said fungi were generally despised as having, with a few exceptions, poisonous properties, but when they were better understood they would furnish many new dishes for the table. The sections he purposed dealing with were those of the Myxomycetes and Discomycetes, microscopic forms that would rival in beauty and colour many favourite objects. The writer mentioned a large number that were specially suitable as objects for the lower powers of the microscope. The latter part of the paper dealt with the collecting of fungi, and the importance of keeping each kind by itself, and the localities in the district that have proved particularly prolific in these objects, some of them yielding as many as twenty-six species in an afternoon's work. The paper was illustrated by a collection of specimens, and some objects under the microscope.—April 1st. Mr. J. W. Neville exhibited specimens of *Olenus scarabæoides*, a Trilobite from the upper Lingula Flags, near Bala, and specimens of *Orthis lenticularis* from the same formation; Mr. C. P. Neville, a

collection of shells from the Straits of Magellan; Mr. J. Madison, *Bulimus pacificus*, from Queensland, also *B. arelaira* and *Corbicula nepeanensis*, from New South Wales.—April 8th. Mr. W. H. Bath showed a specimen of the great green grasshopper, *Phasgonura viridissima*, from St. Albans; Mr. A. Camm, a fungus, *Virgaria nigra*; Mr. J. W. Neville then gave an exhibition of lantern pictures of "Pond Life." They comprised a series of drawings of the Infusoria, Rotifera, Polyzoa, Entomostraca, and other interesting slides, including nest of stickleback, homes of water spiders, &c., &c. A short description of the life and habits of the different objects was given.—April 15th. Mr. C. P. Neville exhibited a collection of Silurian corals from Wenlock and Benthall Edge. Mr. J. Moore read a paper on "Simple Methods of Staining." The process adopted by the writer was simple in the extreme, only two dyes being used, an aniline dye and logwood, to both of which a little alum should be added. Any of the aniline dyes would answer the purpose, but he gave preference to magenta and green. Every degree of intensity could be obtained by strengthening or diluting the solution. If the colour was found too intense it could be reduced by soaking in spirits of wine. Objects stained with aniline dye could be mounted in Canada Balsam; and those coloured with logwood, in glycerine or glycerine jelly. A number of objects stained by this process were shown; they consisted of palates, wood sections, and insect preparations, and had been mounted for five years.

OXFORDSHIRE NATURAL HISTORY SOCIETY.—Tuesday, April 2nd, 1889; Rev. J. W. B. Bell in the chair. The Secretary read a letter from the President, Mr. E. B. Poulton, stating that arrangements were being made with the editor of the "Midland Naturalist" to publish a selection of the Society's lectures in that magazine, and he therefore suggested that a considerable number of members would like to take it in. The meeting was a small one, owing to its being vacation, but a list of twelve subscribers was made out. Mr. Henry Balfour then gave a lecture on the "Finmarken Whale Fishery." Briefly describing the two genera of whales—the Right and the Fin whales, he said that while the former were hunted in the Greenland fishery, the latter, which are much larger animals, alone appeared off the coast of Finland; they are called Rorquals. There are several species. An average size is sixty to eighty feet long, and some are even longer. To the Greenland fishery, as all knew, large ships went out, and the whales were harpooned from small row boats. The Finmark whales, on the other hand, are hunted from small 80 to 100 ton steamers, having a powerful harpoon gun fixed on a swivel in the bows. The harpoon itself was a terrible weapon of steel, six feet long, and carrying in its point, besides barbs, a shell, which was made to explode within the animal after it had been struck. A small model of one of these instruments was shown, and a whale hunt vividly described. The dead whale is towed to shore at the whaling station. The process of cutting off the blubber and rendering the oil was also gone into, and all the surroundings of a whale factory explained. The whale fishery is a very interesting study for a naturalist, and a visit to its head quarters gives one a pleasant voyage along the coast of Norway, round the North Cape to Finland. It has only one drawback—a whaling station is excessively mal-odorous; but the enthusiastic naturalist will not mind this. The lecture was illustrated with diagrams, pictures, and specimens. Everyone has heard something of the Greenland whale fishing, but this account of the Finmarken fishery, like the industry itself, is new to most people.

WILD BEES.

BY R. C. L. PERKINS,

JESUS COLLEGE, OXFORD.

(*Continued from page 116.*)

Andrena.

This is the most extensive of our British genera, comprising no less than forty-eight distinct species, and, therefore, there is naturally great diversity of appearance between many of them. They are of simple habits and universal distribution, and many are amongst the commonest of our wild bees. They form cylindrical burrows in the ground, some species preferring bare spots, others grassy banks ; some will make their nests in pathways so hard-trodden that no one would imagine it possible for any bee to pierce the soil, others are partial to loose sand or the finely-sifted soil of a garden flower-bed, while others again will burrow in the stiffest clay. These burrows are just of sufficient size to admit the maker, and reach usually to a depth of from about five to nine inches.

Most of the species form "colonies" of greater or less extent. Sometimes they are so large that a space of some yards will be riddled with burrows almost touching one another ; yet there is no division of labour amongst the individuals of the colony, such as we see in the social bees, but each keeps to its own *nidus* and takes no notice of its neighbours.

The cause of this gregarious habit is obscure : it may have originated from need of protection. Certain enemies may be intimidated by the numbers which are always to be seen round a vigorous colony. At any rate, in the case of *Anthophora*, another genus which forms huge colonies, this is probably the case, and I know that many people unacquainted with these bees would hesitate before approaching very close to one of the enormously populous colonies of *Anthophora acervorum*.

On the other hand, I have already mentioned the ravages of the *Forficulæ*, to which colonies are especially exposed, and, similarly, insectivorous birds not unfrequently pay them visits.

There is some reason to think that in some cases at any rate the sole cause of such colonies lies in the fact that the

place chosen at first is very suitable to the species, and that the descendants of the first comers continue to make use of this very favourable spot, so long as there remains room for their increasing numbers.

The striking difference between the male and female in general appearance in some species is noteworthy. No one, for instance, would ever guess that the male and female of *Andrena fulva* belonged to the same species. Many of, if not all, the species of *Andrena* will emit a more or less powerful scent on being handled, which is often, but not always, of a pleasant nature. This power is by no means peculiar to this genus, but is rather the rule throughout the genera of bees than the exception ; nor is it confined to one sex as in many other insects, *Pieris napi* for instance, in which the male alone has acquired this property. For I know from my own observations that, in many species at any rate, both sexes have this power, but in the case of many others, the males of which I have noticed as emitting a powerful odour, I have not examined the live females in the field to asertain whether they also have this same power.

With regard to the species of which *both sexes* emit an odour, and I believe most bees belong to this class, we can hardly be wrong in assigning a protective value to this property. It must be remembered that although to a hymenopterist a bee is a bee, and in appearance very distinct from other insects, yet there are many enemies of insects which would not distinguish perhaps even most bees from flies ; and further, it is of course the females only of bees which possess a sting, so that the males, especially when they possess an appearance rather distinct from the other sex, would be very liable to be preyed upon. But even if the scent of the male was not in itself disagreeable to certain enemies, it is highly probable that in cases where it is of a similar nature in both sexes the enemy would associate the particular scent with the idea of something harmful, and so the male would escape although without a weapon of defence. Such a means of escape, too, is all the more important, when we consider, that the males of bees emerge generally a week or ten days before the appearance of the other sex.

Of the special enemies of the *Andrenæ* there are the brightly marked parasitic bees of the genus *Nomada*. They are amongst the most interesting of our native bees. Many of the species are very similar in general appearance to wasps, having bright yellow bands on a black or brown ground colour, the rest are black and brown, often with minute yellow markings.

But before entering into a discussion of these colours, it is better to speak of the attacks of the *Nomadæ* on the *Andrenæ*.

It is generally stated that they are allowed by the *Andrenæ* to enter their burrows "without let or hindrance," and, in a way, this would seem to be correct. But it should be noticed that these parasites are extremely cautious in entering a burrow, hovering for a time at the mouth, or often entering a little way, and then flying off to another; without doubt, such behaviour is due to their fear of encountering the *Andrena*, if at home. On the other hand, if the *Andrena* returns when the parasite is within, as must sometimes happen, she waits until the latter has flown off: so that both, it would seem, equally avoid an encounter.

Another reason for this belief is found in the fact that (except of course when recently emerged from the pupa stage), the *Nomadæ* do not rest at night or in bad weather in the burrows of the *Andrenæ*: but above the surface of the ground.

Shuckard, in his "British Bees," noticed that while a colony of bees would continue to abound in about equal numbers year by year, their parasites would be abundant one year and very rare another. He did not however see the cause of this, and I am not aware that it has been mentioned by any of our other hymenopterists. It is certainly because they are thus exposed to all weathers, that the great variation in their numbers in different seasons is due: while bad weather does not *equally* affect the *Andrena*, which is sheltered in its burrow.

Even the habit among parasitic bees of sleeping out seems hardly to have been observed, though other genera besides *Nomada* do so—for instance, *Melecta*, which I have frequently found so circumstanced on the wettest days, and *Epeolus* has been noticed by Linnæus as attaching itself to the beak of the flower of *Geranium Phæum*. The *Nomadæ* often choose as a place of rest the flower heads of various grasses; attaching themselves to one of these by the mandibles, they draw up their legs close to the sides of the body, fold their wings over the back, and extend their antennæ straight out in front. In this position they are in perfect harmony in form and colour with the flowers or seeds of grass, and very difficult to detect, even more so—allowing for their smaller size—than is the butterfly, *Thanaos tages*, when at rest in the same situation. With regard to this butterfly, it is solely from its habit of resting on grass heads and the blossoms of rushes that it sleeps on these with wings deflexed like a moth, whereby a more perfect concealment is

attained than would be possible if it kept its wings erect. And it is most interesting to note that specimens caught on dry hill-sides, where it rests on grass heads, are more variegated than those caught in marshy places where rushes abound, just as the blossoms of grasses are more variegated than the blossoms of the rush.

To return to the bees, the wasp-like colouration of many of the *Nomadæ* is worthy of consideration. The number of insects which mimic the *Vespidæ* is immense. Familiar instances are found in *Diptera*, *Coleoptera*, and *Lepidoptera*, and it is interesting that similar instances should occur amongst the stinging *Hymenoptera*. I think there are no more truly vespiform insects than these *Nomadæ*, and many of the Fossorial *Hymenoptera* are also exceedingly wasp-like.

One of the species of this genus was used by Mr. Poulton in his experiments (Proc. Soc. Zool., March, 1887) on the "Value of Colour and Markings in Insects," and he found it was untouched by any of the lizards to which it was offered. As the *Nomadæ* have the power of emitting an odour, which is no doubt protective, this should also be taken into account in the experiment.

The colours of the other species of the genus, which are chiefly brown and black, may also be warning ones, for they are very conspicuous when the insect is on the wing, but it is these species which are the most beautifully protected when at rest.

Here then is a genus the members of which are protected by a scent, by protective resemblance, by warning colours, and by a sting; but it is clear that insects so protected cannot often require to use that sting, and I feel sure that it is from this cause that of all our bees, or at least of those of equal size, the sting of the *Nomadæ* is the least painful. Even if they do succeed in piercing the skin, the pain is exceeding slight and lasts only for a minute or two. The Fossor *Philanthus*, too, which I have mentioned as provisioning its cells with bees, has a fierce wasp-like appearance; when handled it appears to make no attempt to sting. Many of the larger species of Crabro also, which I have often found carrying off large flies to their cells, look like large-headed wasps, and though I have occasionally handled them I do not remember ever being stung by them.

I must now pass on to another enemy by which *Andrena* is attacked, namely, the very curious genus *Stylops*; indeed these insects are so peculiar in structure that the late Mr. Kirby made for them a new order, which he called *Strepsiptera*. The fore wings or wing-cases of the male are

twisted and small, the hind ones broad, folding up like a fan, and the eyes are placed on a stalk. The female has neither eyes, mouth, nor legs, and, with the exception of the flattened thoracic portion which projects from between the terminal abdominal segments, is entirely concealed within the bee. Generally only one is present in a single bee, but sometimes two or even three may be found. The degeneration which this sex has undergone is, of course, due to the fact that it has no need to leave its host; but as the sexes are parasitic in separate hosts the male has naturally not degenerated to the same extent. All the species are very minute, and the males may be obtained by keeping Andrenas alive in captivity. They are seldom met with abroad. The *Strepsiptera* also attack *Halictus* and other genera of bees, and in other countries *Vespidæ*, *Homoptera*, and ants have been found stylopized. These insects are now generally considered as *Coleoptera*, and are placed near to the genus *Meloë*, which is parasitic on *Anthophora*, and which in its life-history rather resembles *Stylops*.

Stylops is ovoviviparous, and the larvæ are at first active hexapods. They crawl about on the hairs of the bee, and when it visits flowers they get on to these. Undoubtedly, enormous numbers of these larvæ, as also of *Meloë*, must perish, for they cling to and are carried off by any insect which may happen to visit the flower or to brush against the grass to which they cling. I have seen a specimen of *Nomada* so covered with the larvæ of *Meloë* as to be quite unable to fly.

When, however, the active *Stylops* larvæ have been transported to the burrow of the species on which they are parasitic (as happens to but a very small proportion of their number), they make their way into the larva of their host, and then undergo an *ecdysis* which entirely changes their form. They lose their organs of locomotion, and become cylindrical maggots, feeding in the interior of the larva. They reach the pupa stage when their host is on the point of emergence, and then bore through the body of the bee. One could hardly find a better instance of the entire dependence of the form of the larva on its mode of living, for we see in a single species the active form occurring at first when the insect has to go in search of food; then, when it is surrounded with all that it requires, it takes the maggot-like form which is always assumed under such circumstances.

(To be continued.)

FORAMINIFERA OF OBAN, SCOTLAND.

BY E. W. BURGESS.

(*Concluded from page 120.*)

44. *Lagena faba.* Balkwill and Millett. 1884.
    Balkwill and Millett (G.), 1884, p. 13, pl. ii., fig. 10.
    H. B. Brady, Syn. Rec. Brit. Foram., 1887. Jour. Roy. Mic. Soc., p. 905.
    Mr. Brady observes; "I greatly doubt the wisdom of attempting to separate such specimens from *L. lævigata* and *L. marginata.*" Very common.

45. *Lagena quadrata.* Williamson, 1858.
    Williamson (R. F.), 1858, p. 10, pl. i., fig. 27.
    Balkwill and Millett (G.), 1884, p. 14, pl. iii., fig. 1.
    Balkwill and Wright (I. F.), 1885, p. 341.
    Wright, J., 1885-6. Proc. Belfast Nat. Field Club, p. 321, pl. xxvi., fig. 9.
    Is it worth while, considering the variety of form, and also the depth and closeness of markings of *L. sulcata*, *semistriata* and *striata*, to separate such forms as these from *L. marginata*,—they seem to agree often both with *L. marginata* and *L. lævigata*? Rare.

46. *Lagena orbignyana.* Seguenza, 1862.
    Williamson (R. F.), p. 9, pl. i., figs. 19-20.
    J. Wright, 1880-81. Proc. Bel. Nat. Field Club, p. 181, pl. viii., figs. 5, 5A.
    Balkwill and Millett (G.), 1884, p. 14, pl. iii., fig. 1.
    Balkwill and Wright (I. F.), 1885, p. 341.
    A lagena which has a flattened, biconvex form, produced into a neck and three keels, the middle one being the largest. Rare.

47. *Lagena pulchella.* Brady, 1866.
    H. B. Brady, 1866. Rep. Brit. Assoc. Nott., Trans., p. 70.
    H. B. Brady, 1870. Ann. and Mag. Nat. Hist., Ser. 4, Vol. vi., p. 294, pl. xii., figs. 1A-B.
    Balkwill and Millett (G.), 1884, p. 14, pl. ii., fig. 13.
    Robertson, D. (W. S.), rare.
    Differing from *L. clathrata* by the costæ branching; a variation of *L. orbignyana.* The specimens from Oban, 1883, are very fine and typical. Rare.

48. *Nodosaria pyrula.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 17, pl. ii., fig. 39.
Balkwill and Wright (I. F.), 1885, p. 343, pl. xii., fig. 23.
Robertson, D. (W. S.), 1874, rare.
An elongated variety, with inflated segments, usually smooth, the ends of which are long, narrow tubes. Rare.

49. *Nodosaria scalaris.* Batsch, 1791.
Williamson (R. F.), 1858, p. 15, pl. ii., figs. 36-8.
Robertson, D. (W. S.), 1874, common.
The chambers vary in number, the costæ also, both in number and in the fineness or coarseness of markings; mostly two-chambered. Frequent.

50. *Nodosaria communis.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 18, pl. ii., figs. 40-1.
Robertson, D. (W. S.), from six places.
Oban, 1883. Rare.

51. *Vaginulina legumen.* Linne, 1758.
Williamson (R. F.), 1858, p. 21, pl. ii., fig. 45.
Robertson, D. (W. S.), 1874, rare.
A nearly straight pod-like form, not spiral (fragments only). Rare.

52. *Cristellaria rotulata.* Lamark. 1804.
Williamson (R. F.), p. 27, pl. ii., figs. 52-3.
Robertson, D. (W. S.), 1874, frequent.
Oban, 1883. Rare.

53. *Polymorphina gibba.* D'Orbigny, 1826.
Balkwill and Wright (I. F.), 1885, p. 345.
Robertson, D. (W. S.), 1874, enumerates *P. lactea* frequent, and *P. gibba*, common.
H. B. Brady, Syn. Rec. Brit. For., 1887; Jour. Roy. Mic. Soc., London, p. 912.
"Scarcely separable either in character from *P. lactea*." Rare.

54. *Uvigerina angulosa.* Williamson, 1858.
Williamson (R. F.), 1858, p. 67, pl. v., fig. 140.
A triangular species, tapering towards each end; aperture with a lip like a bottle; surface costate. Frequent.

55. *Globigerina bulloides.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 56, pl. v., figs. 116-8.
Robertson, D. (W. S.), 1874, rare.
The best known form of all Foraminifera. Rare.

56. *Globigerina rubra.* D'Orbigny, 1839.
Wright, J., 1886, Fauna S.W. Coast, Ireland, p. 613, Proc. Roy. Irish Acad. Ser. 2, Vol. iv. (Science.) Rare.

57. *Orbulina universa.* D'Orbigny, 1839.
Williamson (R. F.), 1858, p. 2, pl. i., fig. 4.
Robertson, D. (W. S.), 1874, common.
H. B. Brady, 1870, Ann. and Mag. Nat. Hist., p. 277, p. 298.
Generally spoken of as rare in shallow water, and such specimens are often of a brown colour, likely to be cast aside as not foraminiferous. Rare.

58. *Patellina corrugata.* Williamson, 1858.
Williamson (R. F.), 1858, p. 46, pl. iii., figs. 86-9.
Robertson, D. (W. S.), 1874, rare.
J. D. Siddall, 1886, Liv. Mar. Biol. Com. Report, p. 70, frequent.
A form that at present cannot be mistaken for any other shell, generally frequenting muddy bottoms. Rather rare.

59. *Discorbina globularis.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 53, pl. iv., figs. 104-5.
Robertson, D. (W. S.), 1874, common.
Of a very hyaline texture, strongly perforated, the later segments increase very rapidly in size, the last three or four being half the shell. Common.

60. *Discorbina rosacea.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 54, pl. iv., figs. 109-11.
Robertson, D. (W. S.), 1874, common.
A trochoid shell, of varying height, with three or four coils, each of which contains about four segments, which are convexed, edged, and describe about one-third of a circle, mammillated on the edge, otherwise they might be mistaken for *Rotalia nitida.*
These mammillated edged *D. rosacea*, I think, ought to be called *D. rosacea* var. *mamilla*, Will., as there seems quite as much variety between D'Orbigny's specimens and Williamson's as between *Lagena lævis* and *striata.* Very common.

61. *Rotalia Beccarii.* Linne, 1767.
Williamson (R. F.), p. 48, pl. iv., figs. 90-2.
Robertson, D. (W. S.), 1874, common.
Many of these (Oban, 1883) are very young shells, not incrusted with lime, and therefore in beautiful condition. Common.

62. *Rotalia nitida.* Williamson, 1858.
Williamson (R. F.), 1858, p. 54, pl. iv., figs. 106-8.
Robertson, D. (W. S.), 1874, rare.
A trochoid shell, smooth, few convolutions, segments trapezoidal, very transparent, often of a reddish colour. Frequent.

63. *Nonionina depressula.* Walker and Jacob, 1798.
Williamson (R. F.), p. 97, pl. iii., figs. 70-1.
Robertson, D. (W. S.), 1874, common.
Oban (1883). Common.

64. *Nonionina turgida.* Williamson, 1858.
Williamson (R. F.), 1858, p. 50, pl. iv., figs. 95-7.
Robertson, D. (W. S.), 1874, common.
Oban (1883). These are very fine; the final segment is often half the size of the shell. Common.

65 *Polystomella crispa.* Linne, 1767.
Williamson (R. F.), 1858, p. 40, pl. iii., figs. 78-80.
Robertson, D. (W. S.), 1874, common.
Of this species, it will be noticed that there are few without the spines at the circumference, in connection with which read Prof. Williamson's remarks. Perhaps one of the most beautiful, and one of the most abundant forms in many gatherings. Very common.

66. *Polystomella striato-punctata.* Fichtel and Moll., 1803.
Williamson (R. F.), 1858, p. 42, pl. iii., figs. 81-2-2a.
Robertson, D. (W. S.), 1874, common.
Oban (1883). Common.

67. *Operculina ammonoides.* Gronovius, 1781.
Williamson (R. F.), 1858, p. 35, pl. iii., figs. 74-5.
Common.

PROFESSOR POYNTING ON OUR PHYSICAL BELIEFS.

I have read with much pleasure the able and interesting paper by Professor Poynting on the "Foundations of our Belief in the Indestructibility of Matter," read before the Birmingham Natural History Society, but do not think the matter is yet disposed of.

In dealing with ultimate ideas, and in fact in all reasoning, we take for our premises an assumption that cannot be proved by reason of its generality, but the negation of which is inconceivable. Every step of the argument we base upon

these premises we test in like manner, for if the negation be conceivable, the argument is invalid and falls to the ground. It is mainly over this question of conceivability and inconceivability the noise of the strife is heard.

A student of philosophy, carefully watching every step of his argument and checking it by this method, may be interrupted and disconcerted by someone saying, "But the negation of your assumption, which you say is inconceivable, *I* can conceive with ease." What is the student to do? The process is entirely a subjective one, and there is a possibility of his being wrong. If any defect of mind exists which prevents a clear comprehension of the matter, this defect may as easily be present in the student as in the mind of his critic, and who is to deliver judgment?

Thus Professor Poynting says: "The expansion of a continuous solid is unlike anything else, and is therefore inexplicable, but I hold—and here I think Mr. Spencer would consider me quite hopeless—that there is no difficulty in conceiving of the expansion of continuous matter." Here is an apparent deadlock of the kind just described, but when examined it will be seen that a conception of this character does not hold when stated in plain terms. For Coke says that he could conceive a world in which two and two do not make four, and, extraordinary as this sounds, it is, I venture to suggest, an exactly parallel case, and equally valid with the "expansion of a continuous solid." The latter is verbally intelligible, but has it any deeper meaning? Is it not, in fact, one of those illegitimate symbolic conceptions which Mr. Spencer defines as "such that no cumulative or indirect processes of thought can enable us to ascertain that there are corresponding actualities, nor any predictions be made that can prove them?"

Professor Poynting also contends that, while Mr. Spencer holds that the Indestructibility of Matter and the Continuity of Motion are necessary truths, he thinks it conceivable that they are false. For instance, of course, we can never be certain that we are right. Our conclusions are arrived at and tested by the only instrument at our disposal, our consciousness (upon the validity of which we stake all), and may not correspond in the remotest degree with actual realities and absolute truths; but, though the professor avers he can conceive these great doctrines false, surely he cannot conceive their opposites. We *may* be wrong in saying that matter is indestructible, but can he render into thought its destructibility, or can he form a conception of the annihilation of motion, or, in other words, of something becoming nothing?

I imagine that the bone of contention is the question whether physical truths can be known *a priori* or not? That the Professor takes the latter view is evident from his closing sentence which runs thus: "In fact I suspect that the mind is provided only with machinery ready to arrange the results put into it by the senses, and that it does not contain any results ready made."

Contrary as this is to all metaphysical doctrines by what school soever held, it does not concern us here; all that is desired is to prove it erroneous in its application to physics.

Mr. Spencer, when replying to the "Quarterly Review" which attacked him on this point, October, 1873, so thoroughly threshed out the matter that nothing I could possibly add (even were I so presumptuous) could do otherwise than weaken my case. Mr. Spencer took as his premises a quotation from his critic's chief authority (Thomson and Tait). It was as follows: "Physical axioms are axiomatic to those only who have sufficient knowledge of the action of physical causes to enable them to see at once their necessity." What do we understand by an axiom? Clearly an *a priori* truth. If not, by what process of experiment do you proceed to prove an axiom such as that expressed by the words, "Things that are equal to the same are equal to one another?" It cannot be done, as at every step of the proof it is taken for granted; presuming that physical axioms partake of the same character as those of mathematics. Again the phrase, "To see at once their necessity," also excludes the *a posteriori* view.

Mr. Spencer says: "Though Newton gives illustrations of prolonged motion in bodies that are little resisted, he gives no *proof* that a body in motion will continue moving if uninterfered with, in the same direction at the same velocity." "Does Professor Tait deny that the first law of motion is a physical truth, and denying that it is established *a posteriori*—that is, by conscious induction from observation and experiment? If so, what is the inductive reasoning which can establish it?"

I should like to refer to the opinion of another physicist, Professor Tilden. The practice of pitting authority against authority is often objectionable, but the point he refers to in this connection is of sufficient interest to excuse it. Speaking of the Molecular Hypothesis, and comparing it with the theory of Gravitation, he says: "We possess at present no direct or positive proof even that molecules exist, still less have we any evidence regarding the conditions under which they may subsist in mass . . . . *In neither case does the theory admit of direct experimental proof*; but both are

accepted because they accord fully with the result of observation." If, then, experiment is unable to prove a truth, it follows that the truth is not experimentally derived. As in chemistry, so in astronomy all the fundamental truths which are accepted as valid and from which deductions are made are *a priori*. If this be denied then (to quote Mr. Spencer), "Show us an astronomical experiment."

H. S.

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, M.A., AND J. E. BAGNALL, A.L.S.

(Continued from Vol. XI., page 291.)

198. **Ag. mycenoides,** *Fr.* Rare. Oct. Ansty; Combe, *Adams.*

Sub-genus XX.—INOCYBE.

199. **Ag. lanuginosus,** *Bull.* Woods and parks. Oct. In Lord Aylesford's park at Packington! *With.*, 228. Plantations at Arrow; Oversley Wood, *Purt.*, iii., 213.
200. **Ag. scaber,** *Müll.* Shady woods. Rare. Oct.-Feb. Oversley and Ragley Woods, *Purt.*, iii., 205. Dale House Lane, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.*
201. **Ag. lacerus,** *Fr.* Woods. Rare. Oct. Burton Green Wood, Kenilworth, *Russell, Illustr.*
202. **Ag. flocculosus,** *Berk.* Amongst grass. Rare. Kenilworth? *Russell, List.*
203. **Ag. Bongardii,** *Weinm.* Very rare. Oct. Amongst grass, Edgbaston Park.
204. **Ag. obscurus,** *Pers.* Rare. Sept. Lodge Wood, Warwick, *Perceval.*
205. **Ag. hæmactus,** *B. and C.* Very rare. Sept. Church Lane, Ansty, *Adams!*
206. **Ag. fastigiatus.** *Schæff.* Woods. Rare. Sept. Crackley Wood, Kenilworth, 1863, *Russell, Illustr.*
207. **Ag. rimosus,** *Bull.* Woods and pastures. Not rare. Aug.-Oct. Pastures, Edgbaston, *With.*, 199. Oversley Hill, *Purt.*, ii., 635. Ragley Park! *Purt.*, iii., 406. Warwick, *Perceval.* Kenilworth, *Russell, Illustr.* Ansty, *Adams.* Cawstone, *Rugby Sch. Rep.* Edgbaston Park; New Park, Middleton; Trickley Coppice; Sutton Park; Four Oaks Park; Coleshill Pool; Coleshill Heath; Shawberry Wood; Packington Park; Olton Reservoir; Waverley Wood, Stoneleigh; Alveston Pastures, etc.

208. **Ag. asterosporus**, *Quel.* Woods. Sept.-Oct. Trickley Coppice: New Park, Middleton; Coleshill Pool; Bradnock's Hayes; Sutton Park. No doubt overlooked for *Ag. rimosus.*
209. **Ag. eutheles**, *B. and Br.* Under fir trees. Sept. Red Rock Plantation, Edgbaston (*Ag. cacuminatus*), *With.*, 198. The Spring and Crackley Wood, Kenilworth, *Russell, Illustr.* Corley; Lady Adams' Garden, Ansty, *Adams.*
210. **Ag. descissus**, *Fr.*, var. *auricomus*, *Batsch.* Woods. Rare. Roots of filbert trees, Edgbaston, *With.*, 239. Kenilworth, Sept., 1849, *Russell, Illustr.* Ansty, *Adams.*
211. **Ag. sindonius**, *Fr.* Shady places. Rare. Oct. Red Lane, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.*
212. **Ag. geophyllus** *Sow.* On the ground in woods. Not frequent. Aug.-Oct. Oversley Wood, *Purt.*, iii., 636. Warwick. *Perceval.* Crackley Wood and the Dale, Kenilworth, *Russell, Illustr.* Combe Wood, *Adams.* Coleshill Pool; Trickley Coppice.
213. **Ag. trechisporus**, *Berk.* In woods, amongst ferns. Rare. Oct. Combe Woods, *Adams.* Alveston Pastures.

(To be continued.)

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.

BY W. B. GROVE, M.A.

(Continued from page 109.)

There are several other ways in which the cultivation of Bacteria on a solid stratum can be conducted, besides that previously described. In the first place, if the number of germs in our first plate cultivation is so numerous that the colonies soon become confluent with one another, it is easy to make a second attenuation by taking a small portion of the first and mixing it with a further large quantity of liquefied nutrient gelatine. All that is necessary for success is to thin out the individuals sufficiently and protect the plates of glass from the air. Moreover, if an accidental germ from the air should fall upon the plate, it remains and grows exactly where it falls, and can easily be recognised as a stranger.

But when we have attained a pure stock, it is easier to continue the cultivation in a test tube about six inches long; the lower third of this is filled with nutrient gelatine, and the

mouth closed with a plug of cotton wool; the whole is then sterilised by steaming. A small portion of the material to be observed is transferred by a platinum needle, previously heated in a flame, to the surface of the gelatine in the tube, which (since the material is solid) can be held upside down during the operation. The plug of wool is then restored, and the tube kept at the appropriate temperature in an incubator. If all the precautions are duly observed, the result will be a characteristic and easily watched growth in the gelatine at the bottom of the tube.

Well boiled potatoes, cut in halves with a sterilised scalpel, also furnish a suitable medium for growing certain kinds, and, if they are kept under glass covers, accidental contamination may be avoided. The hands, the glass covers, and everything else which comes near, but is not in actual contact with, the cultivated material, can be washed with corrosive sublimate solution to kill any germs that may be upon them.

It is by the adoption of equally careful precautions that successful results have been attained in the cultivation of the Uredineæ (Leaf-Fungi). In both cases it was seen long ago that nothing but such certainty of cultivation would ever enable us to come to correct conclusions upon the biology and the species limitation of these particular groups, but in both cases, when the desire first manifested itself, it seemed hopeless of realisation. The fact that such success has been reached in the propagation of Fungi in these two groups should confirm our hopes that similar success awaits the ingenuity of some one in regard to other groups, where similar knowledge would be equally invaluable. It is somewhat strange that the greatest certainty of "pure" cultivations should have been attained in the treatment of the most minute Fungi, in which *a priori* one would have expected the greatest difficulty.

One of the points of interest in connection with the Bacteria, which has aroused very considerable warmth of argument, is the question of their pleomorphism, as it is termed, that is, their capacity for assuming at different stages of their growth different morphological characters, so different in fact that they would be set down, if independently observed, as distinct and even widely distinct species.

It is obvious that the method of "pure" cultivations affords a means of settling this formerly vexed question in a satisfactory manner. Many such series of experiments have been performed, and the ultimate result has been to confirm the opinion I have always expressed, that this pleomorphism is

not characteristic of all the Bacteria. Certain species and genera are extensively pleomorphic; to quote the words of an observer, about *Bacterium laminariæ*: "At a given moment, in a pure cultivation, elements of all sizes and forms are to be seen, some like Leptothrix, Bacillus, and Bacterium, others like Vibrio, and others like Spirillum." But, on the other hand, certain genera and species are, so far as the evidence goes at present, absolutely unchangeable and constant in form.

This question has been frequently and warmly debated, but is now set at rest to an extent which would have been quite impossible but for Koch's method of solid media. Whatever care was exercised with a *liquid* nutrient solution, the objection that foreign germs had been introduced during the process could never be entirely controverted.

Distribution of Bacteria.

But, perhaps, it will occur to some that there is one difficulty which nothing that has yet been said will enable us to surmount. In all our manipulations, the things that are used, after being sterilised, must be exposed to the air, and we have been taught that the atmosphere is full of the germs of Fungi. How then are we to prevent these germs from entering and contaminating everything? We might, it is true, perform all our operations under a disinfecting spray; it would be difficult, but not absolutely impossible. Obviously, before we can tell what is our best course, we must carefully investigate the truth of the common belief in the abundance of germs in the atmosphere, and the method of plate cultivation offers exactly the means required for so doing.

If a plate, prepared as before, but without any sowing of Bacteria, be exposed to the air in a certain place for a certain time, every germ which falls upon it will remain where it falls; and then, if the plate be kept at a suitable temperature, every one which is capable of growing under these conditions will develop and produce its colony. These colonies can then be counted, and by that means some idea may be formed of the number of Bacteria in the air of any given place. In this way and others the question has been investigated by several persons, notably by a Frenchman, Miquel, and interesting results have been obtained.

Miquel directed a measured current of air to the surface of a gelatine plate, and counted the germs thus entrapped. He found that a cubic metre of air in the Park at Montsouris contained between ... ... 30 and 700
In the same bulk from the Rue de Rivoli there were 5,500

From the Hall of St. Christopher 6,300
From the Ward of an Hospital 11,000

But of these only one in ten was alive and capable of development; the rest were dead.

This is at the surface of the earth, not far above sea-level. The higher we go the fewer the Bacteria become; and at an elevation of about 7,000 feet they have entirely disappeared. No Bacterium or Fungus spore of any kind was detected at that height. On the surface of glaciers, too, they are nearly absent. The number found in any given locality varies, of course, with circumstances. Immediately after rain, the air, which has been, so to speak, *washed*, contains fewer than at other times. They also vary with the seasons. In the same park at Montsouris, Miquel found 49 per cubic metre in the winter, 85 in the spring, 105 in the summer, and 142 or even more in the autumn. This has been confirmed by Frankland, and thus the common belief in the greater impurity and unhealthiness of the atmosphere in the latter season has been justified. It is easy also to see why it should be so, for autumn is the season when the greatest amount of vegetable putrefaction is going on, and when the opportunities for the increase of putrefactive Bacteria are the greatest.

But there is another consideration which influences more effectively the number of Bacteria present in the air of an enclosed space, and that is the presence or absence of atmospheric currents. Even the smallest germ has weight, and in perfectly still air will fall to the ground. It is found that if the manipulation of the sterilised gelatine takes place in a room where the air is in motion, or where the fallen Bacteria have recently been disturbed by sweeping or dusting, contamination is inevitable, but if all doors and windows be securely fastened, and all the movements be performed quickly, but steadily, then no contamination arises unless the number of germs in the room is enormously great. As an instance of the latter, Dr. Klein records that, after a large number of experiments had been performed in his laboratory with *Bacillus anthracis*, the air became so full of the spores of that species that they introduced themselves unbidden into every cultivation.

Dr. Frankland showed how the quantity of floating Bacteria present can be measured by the number which falls upon a square foot of horizontal surface per minute. The average at Kensington was 279 per square foot; but on a cold windy day 433 fell per minute. In the country 79 fell per minute; in Hyde Park 85. In enclosed spaces, such as rooms, the number was much smaller, but the effect of agitation of

the air was more marked; thus, in a quiet room, 44 fell per minute; but when twenty people were dancing in it the number was increased to 400; and in a third-class carriage on the Underground Railway, containing ten people, it rose to the enormous number of 3,120. It is stated that, during a conversazione of the Royal Society, each cubic metre of the air of the library has contained 43,200 bacterial germs.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 91.)

Lees, in "Botany of the Malvern Hills."

* **G. rotundifolium**, 33. (In the 2nd and 3rd Editions this species is queried. Mr. Lees adds, "Uncommon, and I feel somewhat uncertain of its locality.")

* **G. columbinum**, 33. Ill.

* **Erodium moschatum**, 33. On Lumbertree Bank, Welland Common. (Mr. Lees adds, in the 3rd Edition, "I fear lost by enclosure of the waste.")

* **E. maritimum**, 33. At the eastern base of the North Hill, before the path turns to the Ivy-scar Rock. Plentiful there in 1841. (Mr. Lees adds, in the 2nd and 3rd Editions, "Since obliterated at this spot." "On the northern bank of the Common at Barnard's Green." Ill. *Still growing on North Hill; R. F. Towndrow, 1888. Sp.!*

* **Euonymus europæus**, 18. Ill.

† **Ulex minor**, 34. Lees. *This is identified in the 3rd Edition with the true Ulex nanus of Forster. Probably an error for Ulex Gallii.*

* **Genista anglica**, 34. On Welland Common.

* **Anthyllis vulneraria**, 35. Mostly confined to calcareous strata, where, as at the Croft Limeworks, it is abundant. It also grows at Castle Morton on red marl. Ill.

* **Medicago sativa**, 35.

M. lupulina, 36.

M. maculata, 36. This has been gathered at Hawford, near Worcester, by my friend Mr. Abraham Edmunds, junr. *But in the 2nd and 3rd Editions we read:* Abundant in a grassy path in Mr. Smith's large hop yard at Wick, not far from the Severn, where my friend Mr. Thomas Baxter, of the College School, pointed it out to my notice.

* **Melilotus officinalis**, 37.

Trifolium pratense, 36.

* T. medium, 36.
* T. arvense, 36. Ill.
* T. striatum, 36.
* T. repens, 36.
* T. fragiferum, 36. Side of the road to Welland. Ill.

T. procumbens, 36.

T. minus, 36.

* T. filiforme, 36.
* Astragalus glycyphyllus, 36. Woody hills. W. Ill.
* Ornithopus perpusillus, 36. Ill.
* Onobrychis sativa, 36. Western side of Brock Hill. (*In 3rd Edition.* Croft quarries at Mathon. Gadbury banks at Eldersfield.) Ill.

Ervum hirsutum, 36.

E. tetraspermum, 37.

* Vicia sylvatica, 35. In the coppices of most of the calcareous heights on the western side of the hills. Ill.
* V. lathyroides, 35. On the hills, small. *Queried in 2nd and 3rd Editions.* Ill.
* V. bithynica, 35. On the borders of a large field below the Admiral Benbow, Malvern Wells. On the borders of cornfields at Broadwas; Miss H. Moseley. Ill.
* Lathyrus Nissolia, 35. On the edge of the wood near the Croft Limeworks, Mathon. Also about Madresfield. Ill.
* L. sylvestris, 35. Near Pendock, Portway. Ill.

L. palustris, 35. Only in a marshy meadow on the western side of Longdon Marsh.

Orobus tuberosus, 35.

* Prunus insititia, 23. In hedges about Barnard's Green and Welland Common. Ill. *Perhaps Prunus communis var. fruticosus is intended here.*

P. austera (*P. Cerasus, L.*). Hedges, Barnard's Green. Rare.

* Spiræa Filipendula, 24. On the Old Hills. Ill.

Potentilla Fragariastrum.

* P. verna. On the rocks of the hills.

P. reptans.

P. anserina.

* P. argentea.

Tormentilla officinalis.

* T. reptans (*Potentilla procumbens*).

Fragaria vesca.

* Rubus Idæus, 27. Ill.

R. nitidus, 27. (*R. Lindleianus*, 2nd Edit. 57, 3rd Edit. 73.)

R. affinis, 27.

* **R. rhamnifolius**, 27. (*R. cordifolius*, 2nd Edit. 57, 3rd Edit. 74.)

R. discolor, 27.

R. fruticosus, 27. (*R. argenteus*, 2nd Edit. 56, 3rd Edit. 73. *Probably the same as R. discolor. See Babington, "British Rubi," p. 160.*)

* **R. leucostachys**, 27.

R. carpinifolius, 27.

R. villicaulis, 27.

R. pallidus, 27. *Prof. Babington refers this to R. Hystrix. See "British Rubi," p. 173. Mr. Lees's plant is not the R. pallidus of the Rubi germanici.*

R. rudis, 27.

R. Radula, 27.

* **R. Koehleri**, 27.

R. echinatus, 27. *A form of the last. See 3rd Edit., p. 70, Babington's "British Rubi," p. 209.*

‡ **R. fuscus**, 27. (*Professor Babington refers this to Rubus glandulosus, var. hirtus; "British Rubi," p. 250. The localities are in Herefordshire; see 2nd Edit., p. 52; 3rd Edit., p. 69.*)

R. fusco-ater, 27.

R. diversifolius, 27. *Not in the 2nd or 3rd Editions.*

R. dumetorum, 27. *This I believe to be R. diversifolius of modern authors.*

R. corylifolius, 27.

R. Schleicheri, 27. *This is R. tenui-armatus of the 2nd and 3rd Editions, and is referred by Prof. Babington to R. Balfourianus. See "British Rubi," p. 255.*

R. cæsius, 27.

* **Rosa spinosissima**, 24. Ill.

* **R. Doniana**, 24. Ill.

* **R. villosa** (*mollissima*), 24. Ill.

* **R. tomentosa**, 25. Ill.

‡ **R. scabriuscula**, 24. Cowley Park and Cradley. *A variety of the preceding. A Hereford record.*

R. inodora, 25. In bushy pastures below Malvern Wells, eastward. *In the 1st Edition Mr. Lees states that this is the R. Borreri of Woods; but in the 3rd, 64, he describes it as R. tomentella, Leman. Both are now considered varieties of R. canina.*

(To be continued.)

Wayside Notes.

The Hispid Nature of the Young of Paludina vivipara.—I have been re-reading the very interesting valedictory address by Mr. Wm. Jeffrey to the Conchological Society on the "Nature and Development

of the Hairs or Bristles on some Land and Fresh-Water Shells," printed on pp. 17-25 of the fifth volume of "The Journal of Conchology," and in a note at the end he says: "The young of *Paludina vivipara* and *Planorbis corneus* are also said to be hispid, but these hairs are probably of a very delicate nature, and do not seem to be retained in cabinet specimens." I cannot speak of the latter species, as I have had no opportunity of examining its young in the fresh state since my attention was directed to the note. But of the former species I can positively speak, and in a confirmatory manner. I have some specimens of *Paludina vivipara* alive in confinement, which I took the other day in company with Mr. F. R. Fitzgerald from the "Bathing Pond" on Hampstead Heath, London, N., where this species abounds in almost countless numbers. Thinking these to be pregnant, I rapidly killed two by immersion in a cold saturated solution of oxalic acid, and broke up the shell with a pair of dissecting forceps, cut through the thick columellar muscle, and extracted the animal. On following up the oviduct under water with the needle, in one of the specimens I found two embryos (4 mill. long) bulging out the walls of the oviducal lumen. There were others, but these were the largest, and I carefully extracted them. An examination of the shell-sculpture in these embryos with a lens showed strongly marked carinations (using this word in the sense given by G. W. Tryon in the first volume of his "Structural and Systematic Conchology"), which were even throughout their whole extent with the exception of one at the periphery of the body-whorl and two above it. These, under a low power, appeared to be of a granulate character, as if the ribs had been broken up at regular intervals. On using, however, the three glasses together of my pocket lens I saw that each of these granules was tipped with a little horny-whitish hair, a condition of things which resembles strongly the appearance presented by the knob and its attached cilium, which Engelmann has described on the free surface of the columnar cells in the enteric canal of some molluscs. I may add that the hairs were easily detached by the finger, leaving the granules behind, and that I can offer no explanation of their occurrence unless they may be regarded as a reversion to an ancestral condition, or, at least, explicable by the "fundamental biological law" of Ernst Haeckel.—J. W. WILLIAMS.

NOTTINGHAMSHIRE SHELLS: A CORRECTION.—In a note on p. 94 *ante*, I described *Balea perversa* (Linn.) as not hitherto recorded for Nottinghamshire. This I stated on the authority of Messrs. Taylor and Roebuck, who, in their recently revised "Census of the Authenticated Distribution of British Land and Fresh-water Mollusca," published at the end of my little book, "Land and Fresh-water Shells," do not give this species for the county under note. However, looking over some back numbers of "The Naturalist," I find that on p. 213 of the volume for 1886, there is a note by Mr. W. A. Gain, who records taking it, in company with Mr. Musson, "beneath the loose bark of willow trees growing near the junction and within each of the parishes of Darlton, East Markham, and East Drayton." My friend, Mr. G. W. Mellors, of Nottingham, however, called on me last evening, and he tells me that in Mr. Musson's manuscript list of Nottinghamshire shells which he possesses, it is not so recorded, and that Mr. Musson was exceedingly strict in transmitting all his "finds" to paper. At any rate, though perhaps not as I stated new to Nottinghamshire, the two localities I recorded are evidently new. I take the present opportunity of placing upon record other shells

which Mr. Mellors has sent me from Nottingham. The most interesting are *Helix rotundata* (Müll.), and its var. *Turtonii.* (Flem.), *H. aculeata* (Müll.), *Hyalinia fulva* (Müll.), *H. crystallina* (Müll.), from Kirkby; *Helix virgata* (Da Costa), and its var. *subalbida* (Poiret), from a lane between Staunton and Long Pennington; *Ancylus fluviatilis* (Müll.), from Kirkby; *Helix ericetorum* (Müll.), and its var. *alba* (Charp.), from Alverton; *Cæcilianella acicula* (Müll.), from Tollerton; *Helix caperata* (Mont.), from Staunton; *Paludina contecta* (Mill.), from Newark; and *Bythinia Leachii* (Shepp.), from near Trent.—J. W. Williams.

Leafing of Oak and Ash.—These trees were considerably earlier in the unfolding of their leaves than they were in 1888, and the relative difference in time was also much more pronounced than in that year. During the week from May 18th to the 25th, the oak trees were becoming well clothed in leaves, so that by the latter date there was scarcely a tree to be seen without a full head of foliage. The ash trees were markedly behind, and there were only a few trees that had fully developed their leaves by the 23rd, and these only in favourable situations. In making these observations attention was paid both to the habit of individual trees, and especially to the kind of station. For example, the valley of Luton has slopes on the opposite sides, with eastern and western aspects. On the hill facing the west, there were *young* ash trees that had leaves fairly developed by the 17th or 18th, and were as much advanced as oak trees on the opposite hill top with a northern aspect. But the tall ash trees on this side showed scarcely a sign of leaf, while the oak trees growing near them had their foliage half expanded. It was not till the 23rd to 25th of May that the ash trees with a northern aspect made any marked advance in their foliation, whilst not a few of them were almost bare. In fact, when allowing the eye to range over a near landscape, one could detect the presence of almost every ash tree by its bareness of leaves, which was particularly marked on the 25th. It should be stated that these observations were limited to South Beds, and a portion of the county of Herts adjoining.—J. Saunders, Luton.

Plants in Flower in May.—I beg to submit a list of wild flowers, which, in the week ending 12th inst., came under my notice in North Devonshire, in the neighbourhood of Ilfracombe, Bideford, and Clovelly:—Silene maritima, Lychnis (pink variety), Ground Ivy, Geranium, Bellis perennis, some fields white therewith; Primrose, Violet, Oxalis, Orchis, Garlic, Periwinkle, Black Thorn, Stitchwort (greater and lesser), Cardamine pratensis, Vetch, Dandelion, Hyacinth, Gorse, in luxuriant flower over acres of ground at a time; Anemone, Broom, Marsh Marigold, Greater Celandine, Strawberry, Dog's mercury, Cotyledon umbilicus, Lousewort, Plantain, Milkwort, Chickweed, Groundsel, Mustard Charlock, Lords and Ladies, Raywort (on walls), Ling (on summit of Gallantry Bower, Clovelly), Cowslip, Ranunculus (? species), Germander Speedwell, Water Cress, Trefoil, Spurge, Weasel Snout, Yellow Cow Wheat, Tormentilla, Comfrey, a flower very like "London Pride," Geum (avens), Lamium purpureum, Butcher's Broom, Scarlet pimpernel, Lamium album, Shepherd's purse, Sonchus arvensis (sow thistle!), Ranunculus aquaticus. There was a very pretty creeper beginning to flower, frequently to be seen on roadside walls, the name of which I do not know. [*Linaria cymbalaria*, doubtless.—Ed. "M. N."]—Charles Cochrane, Pedmore, near Stourbridge, May 15, 1889.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION, April 11th. Mr. W. R. Hughes, F.L.S., in the chair. The president reported that he had written to Sir Philip Magnus in reference to the establishment of a Spencer Society in London, suggesting that he should co-operate with Miss Naden for this purpose, and that he had received a reply from him. Also that he had met Sir Philip Magnus at Miss Naden's house where the matter had been discussed. Also that he had had the pleasure of a brief interview with Mr. Spencer at the Athenæum Club, and was pleased to say that his health had undergone improvement. In consequence of small attendance, it was decided to postpone Mr. Buncher's paper to May 9th.—May 9th. Mr. W. R. Hughes, F.L.S., in the chair. The president announced that he had received a further communication from Sir Philip Magnus, informing him that Mr. Clodd would probably join the London Society. Mr. Stone exhibited an autograph letter from Charles Darwin to Asa Grey, containing a very characteristic passage. Mr. Harold Buncher read his paper on "Segregation," an exposition of the twenty-first chapter of Herbert Spencer's "First Principles." An interesting discussion followed.—GEOLOGICAL SECTION, April 16th. Mr. W. B. Grove. M.A., chairman. Mr. Wilkinson exhibited (1) *Lecidea pulchella*, a very rare lichen from the top of Ben Nevis, (2) fine collection of foreign ferns. Mr. Marshall read a paper on "The Gulf Stream and its Effect upon the Climate of England and Norway." An interesting discussion followed, and vote of thanks to Mr. Marshall.—GENERAL MEETING, April 30th. The President in the chair; 90 present. Mr. G. C. Druce, F.L.S., of Oxford, gave his "Notes on a Recent Tour through Spain," illustrated by a very interesting series of lantern photographs, which were exhibited by Mr. C. Pumphrey; including fine views of the principal cities of Spain, and the cathedrals and palaces, and also of Gibraltar, and finishing with the frontier town of San Sebastian, where the recent meeting of the Queens of England and Spain took place. A very interesting description was given of the country and buildings, and especially of the extensive flora of Spain, which includes a large number of rare and endemic species. The lecture was much enjoyed by those present. —MICROSCOPICAL SECTION, Tuesday, May 7th. The President in the chair; 115 present. The Rev. T. Simcox Lea, M.A., of Sapey Bridge, near Worcester, gave a lecture on "Oceanic Islands, from a Collector's Notes," illustrated by lantern photographs of the Sandwich Islands, New Zealand, Fernando de Noronha, &c., and also of Australia, which were exhibited by Mr. C. Pumphrey. These oceanic islands are remote from the great continents, and it was shown that they are distinguished by distinct floras and faunas; Australia has to be included among the number, containing many remarkable genera, especially Eucalyptus, which numbers sixty species. The Sandwich Islands have an extensive native flora, but foreign plants, including many common tropical weeds, have been imported, and have established themselves so firmly that they are encroaching upon and taking the place of the native plants, which are thus being gradually extinguished; the same change is taking place in other oceanic islands. The island of Fernando de Noronha, off the coast of Brazil, is a special example of a native flora

being thus destroyed. This island was visited by Mr. Lea, as a volunteer naturalist, in company with an expedition sent out to make collections for the British Museum. He gave some graphic illustrations of life on the island, which is used as a convict settlement. The temperature, he said, varied only between 78° and 82° throughout the year. Mr. Pumphrey afterwards exhibited a series of lantern photographs, including a number of beautiful illustrations of hoar-frost on trees and shrubs, which he took last winter.—BIOLOGICAL SECTION, May 14th. Mr. C. Pumphrey in the chair. Mr. W. B. Grove, M.A., exhibited *Cornuvia metallica*, a beautiful myxomycete new to the district; also, for Miss Gingell, *Auricularia mesenterica*, *Peziza Adæ*, and the œcidial stage of *Triphragmium ulmariæ*, from Dursley; Mr. J. E. Bagnall showed *Orchis mascula*, *Scilla nutans flore-albo*, and other flowering plants and mosses, from Dursley. An interesting paper by Mr. J. B. Stone, J.P., entitled "Plant Marches, or the Geological Progression of Plant Life," was read, in the absence of the author, by Mr. Herbert Stone. A short discussion followed in which Messrs. Pumphrey, H. Stone, Bagnall, Grove, and T. Clarke took part.—GEOLOGICAL SECTION, May 21st. Mr. Waller, B.A., B.Sc., in the chair. Mr. W. P. Marshall exhibited Spider orchis, from Wye Common in Kent; Mr. Grove, various fungi; Mr. Thomas Bolton, some elvers, sent by Mr. Cullis, from Gloucester. Mr. Grazebrook, of Dudley, read a note, communicated by Mr. E. Pritchard through Mr. W. R. Hughes, on "Gold-bearing Quartz of South Africa." Some fine specimens of the rock were exhibited, including conglomerates, quartzites, and volcanic ash. Mr. Goode exhibited samples of crushed gold-bearing rock, from Victoria, Australia, said to yield :—(*a*) 18ozs. 15dwts. to the cwt., (*b*) 11ozs. 4dwts. to the cwt. An interesting discussion followed, and a cordial vote of thanks to Mr. Grazebrook. A communication was read from the British Association on the subject of Geological Photography.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—April 29th. Mr. H. Hawkes reported on the excursion of the members to Weymouth, and read lists of the flowering plants and seaweeds observed, and afterwards shown at the meeting. Mr. J. Madison exhibited specimens of *Helix cereolus* and *H. Carpenteriana*, from the United States; Mr. Camm, the following Fungi:—*Dothidea ulmi*, *Lachnella nivea*, *Reticularia lycoperdon*, and *Cornuvia metallica*; Mr. Hawkes, a series of marine algæ, with reproductive organs. Mr. G. H. Corbet then read a paper on the "Diffusion of Iron." The writer said he did not purpose speaking of its diffusion in organic nature, but rather of its geological distribution. The various rock systems from the Laurentian to the Chalk were reviewed, with the amount of iron they contained and the forms in which it occurred. The Carboniferous system was particularly rich in this mineral, twenty-five kinds of ironstone being found in our local coalfields. Magnetite, ilmenite, limonite, chalybite, marcasite, hematite, and specular iron ore were described at some length, with the quantity of iron they yielded. This metal, so generally distributed, had been called the "pigment of nature," and, considered with our coal supply, had largely contributed to our national greatness. A collection of the various ores, &c., was shown at the meeting.—May 6th. Mr. J. Collins exhibited a named and mounted collection of marine algæ, from Weymouth; Mr. J. Moore, specimens of *Helix nemoralis*, with an umbilicus; also specimens of *Cyclostoma elegans* var. *ochroleuca*, from Portland; Mr. J. Madison, *Helix Newberryana* and *H. californiensis*,

from the United States. Under the microscopes, Mr. Moore, odontophore of *Cyclostoma elegans*; Mr. Collins, Spirogyra in conjugation.—May 13th. Mr. J. W. Neville showed pensile cocoons (probably of a lepidopterous insect) formed of pieces of stick and covered with silk, from Buenos Ayres; also an albino specimen of house sparrow, from Handsworth, where it came regularly to be fed until its death; Mr. Hawkes, *Uromyces scillarum* and *Œcidium epilobii*. Mr. C. P. Neville then read a paper on "The Life History of a Butterfly." The various stages in the development of the egg, larva, pupa, and imago were described, and the variety presented in the forms of eggs and larvæ was spoken of as very interesting. The "unerring instinct" of the female, always depositing her eggs on the right food plant, was questioned from personal observations. The paper, which also dealt with the development of colour and form with each successive moult, was illustrated by lantern pictures.

OXFORDSHIRE NATURAL HISTORY SOCIETY. — April 30th. The President, Mr. E. B. Poulton, M.A., in the chair; present, about forty-eight members. Five new members were proposed. The Rev. Bedford Pim gave a paper on the "Hydroquinone Process in Photography," illustrated by some of the results of his work. Mr. J. O. Sankey lectured on "Pallas's Sand Grouse," giving an interesting account of this curious bird. Mr. Geo. Harris showed a nest of the Procession Caterpillar, from Arcachon near the Pyrenees, and also briefly described its habits; and Mr. Poulton showed a curious Sphinx Caterpillar, from Africa.—May 14th. The President, Mr. E. B. Poulton, M.A., F.R.S., was in the chair, and forty-two members were present. Five new members were elected and one proposed. Dr. W. Collier gave a lecture on the "Comparative Sensitiveness to Pain of Animals." He was of opinion that animals felt less pain than man, and he founded his belief on the following facts and inferences:—(1) Pain, though felt at the part affected, was produced in the brain, and pain sensations were conducted by nerves more or less specialised for the purpose. Hence, knowing what we do about the brain, it was reasonable to infer that a brain of low development would feel less pain than a highly organised one. (2) It is known that some men feel pain much less than others. These are men of strong muscular development, and of little intellectual power—such as an agricultural labourer. Dr. Collier related several dentists' stories concerning the agricultural labourer, showing how little he felt the pain of tooth-drawing. Savage races, also, were known not to feel pain so acutely as we do. Proceeding to animals such as horses and dogs, various tales were told showing surprising indifference to what seemed very painful injuries. The lecturer also showed how the sudden shock of a severe wound paralysed the nerves at first, so that no pain was felt at the time when the wound was inflicted. He then proceeded to the case of the lower animals, and said it was extremely doubtful if they had any pain-conducting nerves at all, and when injured they showed but little sense of pain. Hence, taking these two arguments together—simplicity of nervous organisation in animals and few signs of pain when injured—he thought that we might safely conclude that their sensitiveness to pain is less than ours, although, of course, the higher animals suffered more than the lower, and all would suffer to some extent. But this comfortable belief, said Dr. Collier in conclusion, by no means excused any cruelty to animals. A discussion followed, and various speakers told tales more or less corroborating the lecturer's theory.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

We are glad to report that a very cordial invitation has been given by the Oxford Natural History Society to hold the Annual Meeting of the Midland Union in that city in the Autumn, and that the Executive Committee of the Union, at the suggestion of the Oxford Society, has fixed Monday and Tuesday, September 23rd and 24th, for the Meeting. These days are in the week immediately following the Meeting of the British Association, at Newcastle (September 11-19), and will, therefore, suit those who wish to attend the great *omnium gatherum* of scientific men and others.

The Union is to be heartily congratulated upon this invitation from the youngest society in its ranks, and we hope that everything will be done to make the Meeting the success it deserves to be. On the part of the host-society, we are assured that no efforts will be spared, and the attractions of Oxford are so great and varied, that the Meeting ought to be one of the largest in the history of the Union.

WILD BEES.

BY R. C. L. PERKINS,

JESUS COLLEGE, OXFORD.

(*Concluded from page 129.*)

Osmia.

Of this genus we have only ten British species, but their habits are varied and interesting, and it will be necessary to take the different species more or less apart instead of speaking of the group as a whole. They have a ventral pollen-brush, and their mandibles are exceedingly powerful, so that some of the species can readily burrow into hard wood.

The habits of many of the species vary under different conditions: *Osmia rufa* for instance, a very abundant species, may often be found forming its burrows in an old tree or post, at other times in the mortar of walls, or in the ground; or it will make use of any ready-made suitable cavity, an old lock for instance, or a hollow stone, and fill them with its cells. It may very properly be included amongst the so called "Mason bees," for it very frequently constructs its cells of

clay in a cavity between the stones or bricks of a wall; it may be seen building in this manner in the Botanical Gardens, any fine day in spring or early summer.

Another species *O. pilicornis* which is a scarce bee, very partial to the flowers of the Purple Bugle, I have found making its nest in hard stony ground, but also in a detached piece of dead wood lying on the surface of the soil. *O. parietina* which frequents hilly or mountainous districts in the more Northern counties, seeks out a stone which encloses a cavity beneath it, and attaches its cells to the under surface of this. The two species *O. fulviventris* and *aenea* generally burrow in posts or rails, but are always willing to make use of the holes which have been made by nails in the mortar of walls. The former bee I have often watched cutting roughly oval pieces from the leaves of rose trees, selecting not the green ones, but those which are yellow and decayed: it leaves a ragged outline very different from the neat work of the leaf cutting bees: and I believe it does not use pieces of leaf of any size, but bites them up to form a kind of cement, with which it separates the adjoining cells.

It cannot be doubted that the exquisite leaf-building of the true leaf-cutters *(Megachile)* arose from some simple habit like this, and we can well imagine the next step to have been the employment of the oval piece entire, as a separation between the cells—a saving both of time and labour—and finally the employment of leaf for all parts of the *nidus*.

Two other species, *Osmia aurulenta* and *O. bicolor*, will burrow in the ground when the soil is suitable, but they often save themselves this labour by making use of empty snail shells, in which they construct their cells, separating them by transverse partitions and finally closing the opening of the shell. But the latter species *(O. bicolor)* is not content with this security, for although the snail shells chosen are generally already well concealed by their position, it uses other means to render that concealment more perfect. Where this bee is plentiful,—and it is usually abundant where it is found at all—you may often catch specimens carrying in their mandibles pieces of dry grass-stalks of considerable length. Grasping these at the middle, they fly off with them to their *nidus*, and arrange them over the shell somewhat in the shape of a dome. The labour of the bee in cutting the number required and bringing them home—often from a considerable distance—must be very great. I have lately heard from Mr. Harwood that he has detected another species, *O. spinulosa*, making its nest in snail shells. I have not found the *nidus* of this species myself.

There is still one species to be noticed, *O. leucomelana*. It is a very local bee and hardly ever abundant, but I have met with it in South Devon, and also with the *nidus*. This is constructed in a dead bramble stem: having found a dry stem of suitable size, it has only to remove the pith to form an excellent burrow. In this it makes several cells, placing in each the usual little pollen mass, and forming partitions between them.

Other British bees make use of bramble stems, *Prosopis* and *Ceratina* for example, and so do large numbers of the Fossorial Hymenoptera, and one cannot but wonder that a still larger number of bees have not thus saved themselves the labour of excavating harder materials.

The genus *Stelis* is parasitic on *Osmia*; we have but three British species of these parasites, all of which are rare or very rare. Not much is known of their habits beyond the fact that like other parasites they enter the burrows of the *Osmia* during her absence and deposit their egg. I have met with two of the species. One wet day I found a female of *Stelis phæoptera* in one of the unoccupied burrows of a colony of the Fossor, *Crabro cephalotes*, which would indicate that like other parasitic bees I have mentioned they do not venture to sleep in the burrow of their host.

In connection with this genus may be noticed the brilliantly-coloured parasitic *Chrysididæ* or Ruby wasps, for the *Osmiæ* are the most liable of our bees to be attacked by them. They are, however, very general in their attacks, the Fossorial section being especially subject to them. Entering the burrows of the industrial bee they deposit their eggs, but, as one would guess from the fact of some species attacking either bees or the carnivorous Fossors, it is not on the food which is stored up that they prey, but on the larvæ of their hosts.

Perhaps the most noteworthy fact in the habits of the Ruby wasps is the special means of protection they have acquired. To save themselves from the sting of the host, on whose young they prey, they roll themselves up into a ball, so that no weak spot in their armour remains open to attack, and many species do attack them with the greatest fury. The Fossor, *Bembex*, is notorious in this respect. A curious fact is told of an assault made by one of the leaf-cutter bees on one of these *Chrysididæ*; on its return it caught the parasite, and, finding it protected in all other parts, bit off its wings, and let it drop to the ground from its burrow, which was constructed in a wall. Nevertheless, when the bee had flown off for a fresh supply of pollen, the parasite crawled up the

wall, and deposited its egg in the cell from which it had been dislodged.

BOMBUS.

The social bees of this genus, commonly called humble bees, are so well known to every one that it is needless to say much about them. Besides the males and female their nests contain a third form, the workers or neuters. On the first warm days in the spring the females of the Bombi may be seen abroad after their hibernation. Each one of these is by herself the foundress of a nest. She chooses a suitable spot above ground, if a surface builder, or some ready-made cavity, such as an old mouse hole, if an underground species, and here unassisted she collects a mass of pollen, and forms a few honey-pots. in which is contained honey enough to keep the larval food sufficiently moist. From the eggs first laid there hatch out workers, which at once aid her in enlarging the nest, and gathering food for the increasing brood. Later on eggs are laid from which males and females are subsequently developed, but these are less in number than the workers.

In the autumn the bees forsake their nest, the females alone surviving the winter. These hibernate beneath the bark of trees or under moss, or bury themselves beneath the soil, and may then be frequently met with when you are searching for Lepidopterous pupæ. At this time they are often almost entirely covered with *Acari*, which remain on them throughout their existence, and from this cause they are sometimes quite unable to fly, and may be seen crawling about helplessly on the ground.

Their nest, with its irregularly placed cells and small piece of comb, and the neat covering of moss or grass by which it is so well concealed, has been described again and again in books, and may be seen on almost any mossy bank and in every hayfield. No bees are liable to the attacks of so many enemies as these, for besides mice, which frequent similar situations, and spoil their nests, birds devour them in immense numbers. Very commonly you may find under the lime trees, sycamores, or horse-chestnuts, when in blossom, many dead specimens of these bees, and many still crawling about although partly eaten. This is the work of tits and other insectivorous birds, which form little bands of from six to a dozen individuals, and having devoured the contents of the body let the remainder fall to the ground. Of the *Lepidoptera*, the *Galleria* is a terrible enemy, its larvæ infesting the nests in such numbers that the young are deserted by the bees.

The Dipterous genus, *Volucella*, preys on their larvæ, and from its abundance must be very destructive. These flies, in

their colours and general appearance, closely resemble the species on which they are parasitic, and so are enabled to enter the nest, and deposit their eggs with greater safety. But, besides these flies, they have other parasites in the extraordinary genus *Conops*, several species of which are usually abundant.

Of bees, the genus *Psithyrus* (=*Apathus*) is parasitic on the bumble bees. In general appearance they closely resemble Bombi, but of course they have no workers, and no pollinigerous apparatus. The females hibernate and deposit their eggs in the spring and early summer, when the Bombi have begun to provide for their larvæ, and amongst these they are developed.

And here, in conclusion, it will be appropriate to say something about parasitic bees in general. Clearly parasites belong to two distinct classes: (i.) those which are nearly related to their hosts, and (ii.) those which are totally dissimilar.

Of the first class the most striking instance is found in these *Psithyri*. There cannot be the faintest doubt that they are degenerate forms of Bombi which, through parasitic habits, have lost their means of collecting pollen and their workers. But other parasites belong to this class which do not *at first sight* resemble their hosts; such are *Melecta* and *Anthophora*, *Megachile* and *Coelioxys*, *Osmia* and *Stelis*. For it is highly probable that the differences between these parasitic genera and their hosts have merely been brought about by their parasitism. Take *Melecta* and *Anthophora*, for instance, what is more likely than that some ancestral species of the latter formed large colonies as *Anthophora pilipes* and others now do, and that some individual took to depositing its eggs in its neighbours' burrows, instead of collecting its own pollen, and that this was continued from generation to generation. Naturally the loss of pollinigerous apparatus would follow (and in a social bee the loss of the worker as well), and other changes would take place in the parasite best suited for the accomplishment of its purpose. I should rather wonder myself if this had not sometimes happened. I have seen a female of the Fossor, *Agenia** *variegata*, which preys on spiders, enter the burrow of another female, probably either to rob or dispossess it, as a furious fight ensued; and I have seen two females of *Pompilus gibbus* fight for a spider which one of them had captured. I have

* Cf. M. Fabre's observations on *Tachytes;* also a Fossor, mentioned by Darwin ("Origin of Species," p. 216).

said above that though *Psithyrus* is so like its host, in the other cases I have mentioned there is not the same obvious resemblance.

Yet from an examination of various structures which one would expect to be the least changed by the parasitic habit, and from the similarity in these between host and parasite, I have not the least doubt that their case is the same as that of *Psithyrus*. I will here quote two passages which support this. Shuckard, in his "British Bees," p. 49, says: "*Melecta* resembles *Anthophora*, *Cœlioxys* has the form of *Megachile*, both in the hollow base of the abdomen and the peculiar manner the latter has of raising its extremity—something like a *Staphylinus*. Many other peculiarities of resemblance might be enunciated." The other is from a paper by Mr. Edward Saunders "On the Terminal Segments of Aculeate *Hymenoptera*" (published in Trans. Ent. Soc., March, 1884), where he says: "Still it is worthy of note that there is often an extraordinary general similarity in the apical segments of the parasites and of the bees with whom they live: *Megachile*, and *Cœlioxys*, *Chalicodoma* and *Dioxys*, *Anthophora* and *Melecta*, are striking instances of this similarity." With regard to the other class I can say little. *Nomada* is an obvious instance. Whether they were originally parasites of forms allied to themselves, or whether from the first they attacked bees totally different in appearance and structure to themselves, I have found no means of deciding. Though now chiefly attacking *Andrena*, it is quite possible that they were not originally parasitic on these bees, since even now we know of two species which attack the *Apidæ* or long-tongued bees, of the genera *Eucera* and *Panurgus*.

Epeolus, however, which equally with *Nomada*, has no affinity with its host, appears to restrict its attacks entirely to *Colletes*.

NOTE ON A GRANITE CONTAINING LITHIA.*

BY MR. T. H. WALLER, B.A., B.SC.

Some time ago I had a sample of rock sent to me by a friend with a request that I would determine the amount of soda and potash contained in it. Following the method of analysis which is, I believe, most generally in use, I obtained a mass of

* Read before the Birmingham Natural History and Microscopical Society, December 18th, 1888.

alkaline chlorides, which I proceeded to weigh. It was immediately obvious, however, that the mass was gaining weight somewhat rapidly, showing the presence of some deliquescent salt. An attempted purification left matters as they were before, and made the absence of calcium or magnesium chloride in any appreciable quantity quite certain. The point of a fine platinum wire was then dipped in the somewhat deliquesced salt, and when this was held in the flame of a Bunsen burner the momentary vivid red flame showed the presence of lithium chloride, which was at once abundantly confirmed, on repeating the experiment, by observing the flame through a pocket spectroscope. On separating the lithium chloride by Gooch's method of using boiling amyl alcohol, the chlorides of potassium and sodium were quite normal in behaviour in the air, being only quite slightly hygroscopic under the then existing conditions of the atmosphere as to moisture and temperature. In this way the lithia in the rock was found to amount to as much as 0·7 per cent. Further specimens were obtained through the kindness of Messrs. Watts, Blake, Bearne and Co., the owners of the Meldon Quarry, near Okehampton, from which the rock was procured, and I have been able to make a more thorough examination of the chemical and microscopical characters of this peculiar granite.

The full analysis gives the following results :—

Silica	72·4
Lime	0·9
Manganese Oxide	0·2
Magnesia	0·2
Alumina	16·0
Ferric Oxide	1·0
Soda	4·6
Potash	3·0
Lithia	0·7
Loss on ignition	0·9
	99·9

In this analysis the amount of oxide of manganese is higher than is usual in bulk analyses of rocks. Attention was at once called to it by the bright green colour of the melt when decomposing by fusion with alkaline carbonates. It occurs apparently as the colouring substance of the tourmaline and possibly in part in the mica.

The comparative quantities of potash and soda will also be noticed; even if the lithia be regarded as replacing potash, there is not such a preponderance as is usual in granites.

The rock is mentioned by Mr. Teall, in his "British Petrography." He says (p. 316): "A remarkable variety of granite occurs at Meldon, near Okehampton. It is almost a pure white, somewhat resembling statuary marble in appearance, and is composed essentially of quartz, felspar (largely plagioclase), white mica, and topaz. Black mica is absent; the rock is therefore a Muscovite granite. It contains also green tourmaline." In a note he speaks of the topaz as occurring in grains which but rarely show good form in thin sections, but gives reasons which make the identification certain.

The constituents of the specimens which I have had the opportunity of examining are, on the whole, of medium size. The dimensions of the separate grains of quartz and felspar, are about the same in all directions, and on an average from $\frac{1}{25}$ to $\frac{1}{16}$ of an inch across—some of the felspars being, however, somewhat elongated. Occasional veins of larger crystals traverse the mass, in which the aggregation of the various minerals is much looser than in the more close grained parts, so that it has not been possible to make sections. As the constituents do not seem to vary in kind, this is not of so much importance, and the easy separation of the mica makes it a simple matter to determine the fact that the lithia occurs in this mineral and not in the felspar. In these veins, too, the tourmaline occurs in fairly large crystals of a beautiful pale-green colour, or sometimes of a very delicate pink. The two colours are often present in the same crystal, the one forming a core, the other surrounding it. The crystals were of sufficient size to permit of the determination of the angle over the edges of the terminal rhomb by means of the reflecting goniometer, and fragments give the blowpipe reaction for boric acid with the utmost distinctness. On examination of a thin slice, we find that almost all the felspar is of one of the triclinic varieties. In such sections as show a symmetrical extinction with regard to the plane of twin composition, the extinction angle is generally low. I have seen no case in which the presence of labradorite or any more basic felspar could be determined, and indeed the very small amount of lime, as found by analysis (0·9%), makes the presence of such impossible.

The question naturally arises as to how the alkalies are distributed, whether both in one felspar or in two separate felspars, such as orthoclase and albite; or, finally, whether most of the potash is present in the mica. The very great preponderance

of the triclinic felspar makes the latter suggestion the more likely, or rather there does not seem enough felspar which has not the multiple twinning to account for the amount of potash present. On separating the constituents as accurately as possible by means of Sonstadt's solution, I could get no satisfactory distinction between the various fractions within the limits of the specific gravities of the felspars. A great many grains, tested by Szabo's flame reactions, showed the preponderance of soda in the felspar, but not such an absence of potash or such a fusibility as would have been expected in the case of albite; and in a few of the cases where the extinction angles could be satisfactorily determined the occurrence of angles of about 40° between the extinctions of the two sets of twin lamellæ makes it more probable that at any rate some of the felspar is oligoclase. Still there was apparently another maximum extinction at about 30°—32° which would best suit albite, and the amount of lime compared with the soda, even allowing that some of this was contained in the mica, seems too low to allow of oligoclase being the chief basic felspar.

In a paper on the Lithia Micas of New England, by F. W. Clarke, in the Bulletin of the U.S. Geol. Survey, abstracted in the Chemical News, June 3, 1887, the author speaks of the chief localities as situated along a belt of albite granite, and furnishing in almost all cases tourmaline of green and pink colours as an accompanying mineral.

The quartz is chiefly noticeable on account of the very few so-called fluid cavities contained in it. Inclusions are common, but they are either flakes and needles of some mineral or minerals which I have not been able to identify, or else ill-defined cloudy masses giving a rather dirty appearance to the quartz. These also occur in the felspar, and in both cases are often heaped in the central parts of a grain, or are gathered into zones, following more or less closely the outline of the grain. In among the larger constituents is found in some parts, indeed pretty generally, a rather irregularly intergrown micropegmatite, or sometimes it has more the look of the finely interlocked grains of quartz which are so common in some of the schistose rocks.

The mica occurs in pearly-white flakes ; those which form part of the mass of the rock very often show but slight cleavage, and have a very slightly pink colour. Fragments held in the flame of the Bunsen burner give the intense carmine colour due to lithia, and it is in this mineral only that the alkali occurs, the felspar, so far as I have seen, giving no trace of it.

Of the accessory minerals the tourmaline has been already mentioned. Occasional patches have the dark blue colour of indicolite, others are very pale green, almost colourless in thin section.

Topaz occurs sparingly and somewhat irregularly, and the grains very rarely show any trace of their crystalline form, and even cleavage cracks are not frequent. Here, again, I have found only very few and very minute fluid cavities, none large enough for any observation as to whether the liquid is carbonic acid or not.

I have also been fortunate enough to get hold of specimens of the junction of the granite with the surrounding slate. In these, as is usual, the junction is perfectly sharp; the size of the crystalline grains of the intrusive rock is hardly perceptibly different up to a small distance varying from $\frac{1}{8}$ to $\frac{1}{16}$ of an inch from the slate, then follows a zone of quartz and felspar of much smaller dimensions, with a few larger crystals, then a very narrow zone of about $\frac{1}{100}$ inch, consisting apparently of the same minerals in grains of about the same size as those in the previous zone, but the felspars contain fewer inclusions, so that the effect is of an almost perfectly clear line. Then follows, suddenly, the slate, here changed into a schist crowded with tourmaline crystals, the ground being made up of a fine mosaic of quartz. It is a curious circumstance that specimens of this schist, taken from within an inch of the junction, show the presence of lithia when tested in the blowpipe or Bunsen burner flame, whereas those at a greater distance show no trace of it. This is possibly due to the development in the schist of a few flakes of a white mica, which, in places, forms veins which look as if they had been originally cracks in the rock. The tourmaline shows only a moderate dichroism, pale yellow when parallel to the shorter diagonal of the polarising nicols prism, brownish yellow when at right angles to it. The crystals frequently show traces of the terminal planes, and are simply crowded with enclosures of some indeterminable mineral; they occasionally have spots of a blue colour in the paler mass in the manner so common in the mineral.

A few grains of a highly refracting substance, which appears to be isotropic, I should refer to a pale garnet, but they show no crystal outlines which would guide one, and are quite small. Another specimen of a pale brownish-white rock, which occurs near the granite, is a hornstone, but I have no knowledge as to the exact relation in space between it and the eruptive rock.

The occurrence of tourmaline is very frequent among the granites of Devon and Cornwall, and topaz occurs occasionally, as at St. Michael's Mount, and both minerals are constantly associated with tin stone. The presence of fluorine in these minerals has suggested to some geologists that they are secondary formations, and that it is possible that the gaseous agent in the production of them was the fluoride of tin which is easily volatilised, and is also easily decomposed by the action of water affording oxide of tin for the tin stone, and hydrofluoric acid, which would be able to effect further changes in the rocks. Fluorine is also a constituent of lepidolite, so that the association of minerals is quite a natural one.

The presence of lepidolite among the constituents of the Cornish granites was mentioned by Mr. Allport, in his paper on the rocks surrounding the granite masses of the Land's End (Q. J. G. S., 1876), and I have mentioned to this Section the very widespread diffusion of lithia among granitic micas from all parts of the kingdom, but I have not come across any other except one Scotch muscovite which contained sufficient to at once colour a flame so as to be visible without a spectroscope.

In this connection it is interesting to recall the occurrence of a very large percentage of lithium chloride, viz., 26 grains to the gallon, in a spring in Clifford United Mines, in Cornwall, as mentioned by Dr. Miller.

It is obvious that such a rock as we have before us this evening, on being subjected to those influences which result in the kaolinising of the felspars, and the alteration at the same time of the mica, would be very likely to furnish a spring water with a large amount of lithia.

The spectroscopic means at my command did not enable me to examine the mica for the still rarer alkalies, rubidia and cæsia. They occur in some of the lepidolites of Maine in rather considerable quantity; indeed, I believe, the quantity contained in some (2·44% of rubidia, and 0·72% of cæsia) is larger than in any other known substance, except the mineral pollux, which contains 32 % of cæsia. A thorough examination of the alkalies on a large scale would be of great interest.

It will be obvious that this paper is very imperfect, and it seems worth while to recall the opinion of Professor Judd, that the microscopical study of rocks, even when combined with the chemical study of them, should be subordinated to the geological or field examination, and not take the place of it. In this case it is plain that the question as to the

relations of this particular mass to the ordinary granite of Dartmoor, which at Okehampton is very close, would be very interesting. Is this merely a local variety of the main mass, or is it a separate intrusion? Rutley mentions andalusite as developed in the slates near Okehampton at the contact with the granite of Dartmoor. Are the alteration products constant in the two cases, or is the development of either the tourmaline or the andalusite more or less, so to speak, accidental? To these questions I can unfortunately not pretend to offer any answer, and it would need detailed examination in the field, and then careful examination of the specimens to approach the matter with any hope of success.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 143.)

LEES, IN "BOTANY OF THE MALVERN HILLS."

* **Rubus rubiginosa**, 25. Ill.

* **R. micrantha**, 25. Ill.

* **R. sepium**, 25. *A doubtful record. See note, 3rd Edit., 63.*

R. canina, varieties of—

canina (*lutetiana*), 26.

‡ **sarmentacea** (*dumalis*), 25. Cowleigh Park (*Hereford*).

‡ **glaucophylla**, 26. Between Cowleigh and Cradley (*Hereford*).

surculosa, 26. On the side of a lane leading from Welland Common to Castle Morton and Longdon.

* **dumetorum**, 26. Ill.

* **Fosteri** (*urbica*), 26.

* **R. systyla**, 26. In the copse at the back of the Wells House; in a hedge between Little Malvern Priory Farm and Welland Common; and at Powick.

* **R. arvensis.**

* **Pyrus torminalis**, 23. Not uncommon. Ill.

* **P. Aucuparia**, 23.

* **P. communis**, 23. Ill.

* **P. Malus**, 23. Ill.

* **Lythrum Salicaria**, 23. Sides of water.

* **Peplis Portula**, 21. Welland Common.

* **Epilobium angustifolium**, 21. On the northern border of Welland Common.

E. hirsutum, 21.

E. montanum, 21.

* E. roseum, 21.

* E. tetragonum, 21.

* E. palustre, 21.

* Myriophyllum verticillatum, 40. In the Teme.

* M. spicatum, 40. *See "Midland Naturalist," Vol. XI., p. 306, as possibly in Worcester.*

* Hippuris vulgaris, 13. Abundant in Longdon Marshes, near Castle Morton.

Callitriche verna, 40. *Probably C. platycarpa.*

C. autumnalis, 40. In some deep ditches between Barnard's Green and the road to Madresfield. *Probably C. pedunculata. See 2nd Edit., p. 73; 3rd Edit., p. 95.*

* Bryonia dioica, 40.

* Sedum Telephium, 22. On the Ivyscar and other rocks of the North Hill. Ill.

* S. album, 22. On the rocks of the North Hill, but very seldom flowering. Ill.

* S. acre, 22.

* S. reflexum, 22. Ill.

* Cotyledon Umbilicus, 22. In crevices of the rocks. Ill.

* Saxifraga granulata, 22. End Hill. Ill.

* S. tridactylites, 22. Little Malvern. Ill.

* Apium graveolens, 19. In ditches at Longdon Marsh and Pendock Portway. Ill.

* Helosciadium inundatum, 19. Only in deep stagnant water holes by the brook on Welland Common. Ill.

* Petroselinum segetum, 19. On a marly headland extending eastward from Castle Morton Church. Very local.

* Sison Amomum, 19. In shady lanes.

Ægopodium Podagraria, 19.

Bunium flexuosum, 19. Pastures.

* Sium angustifolium, 19. Rare. Ill.

* Bupleurum tenuissimum, 19. Plentiful on the common by the road side, just beyond Garford Court, Barnard's Green, where it was first indicated to me by William Addison, Esq. Ill.

* Œnanthe fistulosa, 19. E.

* Œ. pimpinelloides, 19. E. Rare. Abundant in many dry fields about Forthampton. Ill.

Œ. peucedanifolia (*silaifolia*), 19. On the borders of Longdon Marsh also in a ditch by the lane between Castle Morton and Longdon Marsh.

* Œ. crocata, 19. About springs and ditches in the fields and coppices near the Chalybeate Spa.

* **Œ. Phellandrium**, 20. In stagnant pools about the Chace. Ill.

Æthusa Cynapium, 20.

Heracleum Sphondylium, 20.

Daucus Carota, 20.

Torilis Anthriscus, 20.

Anthriscus vulgaris, 20.

* **A. sylvestris**, 20.

Chærophyllum temulum, 20.

Scandix Pecten-Veneris, 20.

* **Smyrnium Olusatrum**, 20. Red marl; E.; scarce.

Hedera Helix, 18. Covering the Ivyscar Rock most luxuriantly. On Little Malvern Priory, &c.

* **Cornus sanguinea**, 15. Plentiful.

* **Viscum album**, 41. Parasitical on the Apple, Pear, Hawthorn, Maple, Lime, Ash, Willow, Mountain Ash, White Poplar, Black Poplar, Aspen, Robinia pseud-acacia, Elm, Hazel, and Oak.

* **Sambucus Ebulus**, 20. By the side of a lane connecting Birts Morton with the Ledbury Road. Also in a hedge by the road side at Wick, between Powick's Bridge and Boughton's Nursery.

* **Viburnum Lantana**, 20. W. Ill.

Lonicera Periclymenum, 18.

L. Xylosteum, 18. On the eastern side of Longdon Marsh, and at Powick.

Galium erectum, 15. Near Alfrick.

G. tricorne, 15. In corn fields at the Croft, Mathon.

Valerianella olitoria, 14.

* **V. dentata**, 14.

And var. **mixta**, 14. By the side of the road between New Pool and Hanley Turnpike Gate below the Wells.

* **Dipsacus sylvestris**, 15.

* **D. pilosus**, 15. Below the Abbey, Great Malvern. Most abundant in a lane between the Church and the Priory Farm at Little Malvern. Ill.

* **Onopordum Acanthium**, 38. Near Welland Church.

* **Silybum Marianum**, 38. Ill.

Carduus nutans, 38.

C. acanthoides, 38.

Cnicus lanceolatus, 38.

* **C. pratensis**, 38. Longdon Marsh. Ill.

* **C. acaulis**, 38. On the commons at the eastern base of the hills. Ill.

Arctium Lappa, 38. (*A. majus.*)

A. Bardana, 38. (*Probably A. minus.*)

* Serratula tinctoria, 38. Woods. Ill.

Centaurea Cyanus, 39.

* Chrysanthemum segetum, 39.

C. Leucanthemum, 39.

* Matricaria Parthenium, 39.

M. inodora, 39.

* M. Chamomilla, 39. Ill.

Anthemis Cotula, 39.

* A. arvensis, 39. Fields about the Berrow, plentiful.

* A. nobilis, 39. Abundant on Barnard's Green and Welland Common. Ill.

* Artemisia Absinthium, 38. Ill.

A. vulgaris, 38.

Gnaphalium germanicum, 38. (*Filago germanica.*)

* G. minimum, 38. (*F. minima.*)

G. uliginosum, 38.

* G. sylvaticum, 38. On the End Hill, most abundantly in 1841. Also by the side of the road near North Cottage, Malvern Wells. Ill.

Senecio vulgaris, 39.

* S. sylvaticus, 39. Abundant.

* S. squalidus, 39. On old buttresses near "Betty's Boat," the Priory Ferry, Worcester.

S. erucifolius, 39.

S. Jacobæa, 39.

S. aquaticus, 39. Longdon Marsh.

† S. erraticus, 39. New Pool, Malvern Chace. Omitted in 3rd Edit. *It is doubtful what was intended by this name. If S. erraticus of Bertoloni, it is not British.*

* Bidens cernua, 38.

B. tripartita, 38.

* Conyza squarrosa, 39. (*Inula Conyza.*) Base of Ragged Stone Hill, The Croft, &c.

* Pulicaria dysenterica, 39. (*Inula dysenterica.*)

Pulicaria vulgaris, 39. (*Inula Pulicaria.*) In watery spots on Barnard's Green, &c.

* Erigeron acris, 39. On old walls at Leigh, on the northern side of the Churchyard.

Tussilago Farfara, 39.

* Eupatorium cannabinum, 38.

* Cichorium Intybus, 38. Castle Morton.

Lapsana communis, 38.

(To be continued.)

TWO HITHERTO UNDESCRIBED VARIETIES OF LIMNÆA STAGNALIS (LINN.)

BY JOSEPH W. WILLIAMS.

AUTHOR OF "THE SHELL-COLLECTOR'S HANDBOOK FOR THE FIELD," "LAND AND FRESH-WATER SHELLS," ETC.

I do not hold with giving special variety-names to colour-variations in the shells of land and fresh-water Mollusca, neither do I hold with defining as var. *major*, *maxima*, *minor*, or *minima* shells which differ only from the type-form in largeness or littleness respectively. The colour of the former class can be as well expressed in our native tongue, and the size of the latter can be far better given in terms of measurement. For example, it is as well to say a white *Helix nemoralis* as to say *Helix nemoralis* var. *albescens* (Moq.), and it serves the scientific purpose better to give the height of a form in measurement than to describe it as var. *major*, or var. *minor*, which may be anything above or below a certain set number of millimetres. I have stated my views on variety-naming in a series of four papers to "*Science Gossip*," on "Variation in the Mollusca and its Probable Cause,"—the first part of which, the editor writes me, will appear in the July number,—and to these papers I must refer the reader for an extension of these my views on variety-naming. But I consider, on the other hand, that when a form is found *differing from the type by a combination of structural characters of shell*, it is as well that a special variety name be appended to it. To this class of varieties the two forms of shell of *Limnæa stagnalis* I am now going to describe are to be relegated. I propose to give to them the special variety-names of *elegans* and *contortula*.

Variety *elegans*.—Height, 35 mill.; breadth of body-whorl, 15 mill. Whitish in colour; aperture small, rounded, inner lip ("parietal wall" of Pfeiffer) well pronounced; spire elongated, suture deeper than in type, subscalariform, in general run of spire somewhat like that of the marine shell *Turritella replicata* (Linn.); body-whorl not babylonic, shorter than in type ($\frac{2}{5}$ total length of shell) and revolving more evenly; suture between the body-whorl and the whorl immediately preceding it deeply and triangularly canaliculate. Locality.—Pond in field off Platt's Lane, Hampstead, London. Given to the describer by Mr. G. K. Gude, by whom it was collected.

Variety *contortula*.—Length, 24 mill.; breadth of body-whorl, 9 mill. Shell small, narrow, thin, fragile, light horn-coloured; aperture ($\frac{2}{5}$ total length of shell), same shape as in type; body-whorl and the preceding whorl rounded and not babylonic; the fourth and fifth whorls equal in size and markedly gibbous all round; suture of the spire markedly deep, but the suture between the body-whorl and the whorl immediately preceding it no deeper than in type; spire subscalarid. Locality.—Pond in field at East Finchley, London. Collected by the describer.

The pond in which I found what I have called var. *contortula* is thick with aquatic plants which probably may have had something to do with its scalariform nature; the pond, however, in which Mr. Gude found what I have called var. *elegans* is personally known by me as containing but scant vegetation. As both these varieties are subscalarid and since one of them was found in a pond clear of vegetation, it seems to me that subscalarid specimens are not always explicable by the theory of Van den Broeck, who considers them as adaptive modifications. It seems but right, in conclusion, to say that Cockerell has described two varieties of *Limnæa stagnalis* as m. *scalariforme* and v. *elegantula* (the types of which I have examined), but these are quite distinct in general form from the varieties here named and described. Cockerell's two varieties will be found figured and described on pp. 78 and 79 of my "Shell-collector's Handbook for the Field." The description of m. *scalariforme* is "whorls disunited;" that of v. *elegantula* is "shell dark in colour, nearly scalariform; suture deep." The type of the former is in the National Collection in Cromwell Road, South Kensington; the type of the latter is to be found in the Museum of the Middlesex Hospital Medical School, London.

Reviews.

A Flora of Herefordshire. Edited by William Henry Purchas, Vicar of Alstonfield, Staffordshire, and Augustin Ley, Vicar of Sellack and King's Capel, Herefordshire. 8vo, 21s. Hereford: Jakeman and Carver.

FEW works are more interesting to the botanist than a reliable and well-compiled Flora of a district. To possess these characteristics it should proceed from those having a practical knowledge of our native plants, judgment to discriminate species from sub-species, and native plants from aliens, casuals, and the like. If, in addition to this, special features in the habit and distribution of the plants are given, it will add to our knowledge and materially increase the interest of the

work. It should also be a faithful record of all plants observed, whether native, alien, or casual, care, however, being taken to convey to the reader the true status of each plant recorded. Such a flora is a real gain to Science, and such a flora is the one now under review ; in all the points mentioned it is all that can be desired.

But beside this there should be not only a general account of the district, but also of its area, extent of cultivation, with some account of its meadows, woods, rivers, marshes, heath lands, and the like, with comparative lists of the plants of near or contiguous districts ; in this respect the Flora of Herefordshire is scarcely level with the times. Still its excellencies are great, and quite condone for its shortcomings.

The work opens with a preface in which the authors acknowledge their indebtedness to some of the higher lights of botanical science, and give a short history of the progress of Botany in Herefordshire, together with the names of many of the past and present botanical investigators of that county; and from this we learn that so far back as 1845 Mr. Purchas, the elder of the editors, had made an almost complete list of the plants of Herefordshire, so that the work of which this volume is the record was commenced nearly half a century ago. A summary of the Flora of Herefordshire was published in the Woolhope Club Transactions of 1867, and in this 863 species were recorded. In the present work, which is the first separate Flora of that county, we have 903 species recorded.

A few of the greater elevations and characteristics of the Black Mountain and Malvern Hill ranges are also given. From these we learn that the highest point of the county is attained on the Ffwddog ridge of the Black Mountain at Cwarel-y-Fan (about 2,300 feet) ; the extreme northern point of the Hatterill ridge, where it overlooks the town of Hay, coming next with an altitude of about 2,200 feet. Of the Malvern Range the highest point in Herefordshire is the Herefordshire Beacon, with an altitude of 1,390 feet. The undulating plain of the county has a mean altitude of about 200 to 290 feet. A description of the various grades of species is quoted from Watson's Compendium, but no general summary is given ; this would have given additional value to the work. The types of distribution are described, but these types are not given in the text but are relegated to the "Index to the Phanerogamic Plants"; and here the authors have gone beyond Mr. Watson, and included under their various types many plants not so recognised by Watson. The preface concludes with an account of the rainfall, climate, temperature, &c., of Herefordshire, by Mr. Henry Southall, F. R. Met. Soc., which is both interesting and valuable. This is followed by a definition of the botanical districts of Herefordshire, by the Rev. W. H. Purchas ; with notes on their geology by the Rev. W. S. Symonds, F.G.S., Rector of Pendock. This occupies twenty-eight pages, and is a very full account.

The county is divided into fourteen districts, the division being a purely artificial one ; but, as this is accompanied by an excellent map, little is left to be desired. No plan of the Flora is given, but the reader learns incidentally on page 3, in a note on the White-flowered Aquatic Ranunculi : "The division and names here adopted are, as elsewhere in this Flora, those of the London Catalogue of British Plants, Ed. VII., 1874. Although in the case of the plants now under consideration, its classification cannot be considered very fortunate or instructive."

Following the account of the districts is the Flora, which includes the Flowering Plants, Ferns, Mosses, and Fungi, and occupies, with the

Appendix, 529 pages of really small print. In this Mr. Purchas is responsible for the notes and determination of the Brambles and Willows, Mr. Ley for those on the Roses and Mosses, and various distinguished members of the Woolhope Club for the Fungi. This portion of the work reflects the highest credit on both authors; is brimming with information gleaned by extensive reading, made charmingly interesting by the copious notes on many of the critical genera and species; and all the way through the reader feels he has before him the results of the experience and close observation of capable workers in Botany. The weak part of the Flora is the Batrachian Ranunculi, which the authors have evidently shunted; but the Brambles are very ably treated, so also are the Roses and the Willows. The account of the distribution of the Mistletoe is very full, Herefordshire being evidently its headquarters. This record is mainly copied from a valuable paper by Dr. Bull in the Transactions of the Woolhope Club, 1864, and gives in every case the host-tree upon which the plant has been observed, and the list is quite an instructive one. Long notes are also given on the Oak, the Beech, the Helleborines, and *Juncus tenuis*, which is an interesting addition to the English Flora.

The account of the Mosses of Herefordshire, by Mr. Ley, reflects the highest credit on his industry and close observation. The list is a very full one, and many of the species recorded are among the rarest of our British species, one of these, *Bryum versicolor*, being new to the British Flora.

The lists of the Fungi of Herefordshire, "which were originally compiled by Dr. Bull, and after his death were elaborated by Dr. Cooke and Mr. Phillips," are the result of the keen search of the ablest and best of our British fungologists for a long series of years, and testify not only to the industry of the members of the Woolhope Club, but also to the peculiar fungus wealth of Herefordshire. This account occupies seventy-one pages, and comprehends the whole of the great groups from Agaricus to Myrothecium.

The list of Fungi is followed by an Appendix, in which we have an account of the plants added to the Flora during the time which has elapsed since the earlier pages were printed; a Corrigenda in which the comparatively few mistakes to be found in the text are corrected, and three Indices.

The following summary will show the richness of the record in this volume :—

Phanerogams	865
Filices	26
Lycopodium	2
Equisetum	6
Characeæ	4
Casuals	63
Varieties	96
Musci	288
Varieties	20
Fungi	1,097
	2,467

The work is illustrated by a large and well-printed map showing the botanical districts, and three plates on which are delineated *Epipactis ovalis*, *Epipogum aphyllum*, and *Juncus tenuis*. It is well printed, the type being clear though small, and in every way reflects credit on the authors and their publishers. J. E. Bagnall.

A Handbook of Cryptogamic Botany. By A. W. BENNETT and GEO. MURRAY, with 378 Illustrations. 473 pp. Price 16s. Longmans, Green, and Co., 1889.

THE foundations of this handbook—the first published in the English language since 1857—are the works of Goebel and De Bary, whose methods are followed, and from whom and similar sources many of the illustrations are, by permission, borrowed. It is, therefore, a presentation of the biology and classification of cryptogams according to modern German methods, and every attempt has been made to include all recent discoveries up to the time of publication. The figures, as will be seen, are very numerous and seem to be all carefully chosen, so as to help the understanding of the text. It is natural to judge of the value of a book which traverses so wide a field by examining that portion of which one has the most intimate knowledge; and, estimating this by its treatment of the Fungi, it is not too much to say that it stands alone among English works in giving a comprehensive view of the subject in its modern aspect. To one who has been confined to the old-fashioned treatment in vogue in English treatises on systematic mycology, it will be a revelation of a new world. A praiseworthy attempt is made to simplify the nomenclature of the parts described by anglicising the terminations; thus *antherid*, *mycele*, *apothece*, *archegone* are formed by dropping the usual ending, although *prothallium*, *indusium*, and others remain untouched; and, as far as possible, the same term is used throughout for homologous bodies. One of the most enjoyable proofs of the independence of the authors in this respect is that they have refused to follow the debasing German practice of using the word *gonidium* instead of *spore*. It certainly requires a German mind to appreciate the charms of such a word as "macrozoogonidium;" *megazoospore* is sufficiently long. The reasoning, moreover, by which the change was attempted to be enforced by German despots, was characteristically weak and pointless; if it is right to mark the distinction between sexually and asexually produced means of multiplication by a difference of term (as, no doubt, it is), a comparison of previous nomenclature shows that the word "spore" has been used twenty times in the latter signification for once when it has been used in the former; and, therefore, convenience, which overrides all other considerations, requires us to invent a new term for the sexual product rather than for the asexual. Thus the authors of this work are no mere slavish copyists of German magnates, and even those who are acquainted with the original authorities will find much that is new and much that is interesting in their treatment of the subject. An especially well-written part is that which treats of the fossil vascular cryptogams. W. B. G.

Young Collector Series. Land and Fresh-water Shells. By J. W. WILLIAMS, M.A., D.Sc. London: Swan Sonnenschein & Co.

THIS little manual is undoubtedly one of the best of the series. It begins with a chapter on collecting land and fresh-water shells and their inhabitants; then follows a capital description of the anatomy and physiology of the snail and fresh-water mussel. These latter chapters are admirable, and form a very important and valuable feature of the book; they certainly ought to inspire the reader to investigate the differences in the soft parts of the various species in addition to collecting their shells. Then comes a classification of the group, with a minute description of the various British species and varieties; a chapter on the geographical distribution of these, by Messrs. J. W.

Taylor and W. Denison Roebuck, closes the book, which is very good in all respects. We can only suggest that in a future edition a few references should be given to the great standard works on the subject, where the "Young Collector" would find accurate pictures of the different shells to aid him in their identification; such works are usually to be found in most large public libraries. A. B. B.

Wayside Notes.

MANCHESTER MICROSCOPICAL SOCIETY.—From the annual report for 1888 we learn that the Society consists of 222 members, and is in a flourishing condition. The transactions for the year include some interesting and valuable papers. One of the best is the Presidential Address on "Inheritance," by Professor A. Milnes Marshall, F.R.S. Some suggestive details are supplied of a course of systematic histological instruction given by members of the Society; and other societies of the same kind might, we think, follow their example with advantage. The work done was the demonstration of the Structure, Chemistry and Physics of the Vegetable and Animal Cell. The course lasted about six months, and at the closing meeting of the session the chairman gave a *resumé* of the work done, and there was an exhibition of nearly 100 slides under the microscope illustrative of the subjects of the demonstrations made during the course.

UNIVERSITY INTELLIGENCE.—Mr. G. C. Druce, of Oxford, a frequent contributor to these pages, and author of "The Flora of Oxfordshire," has had his merits as a scientific botanist honourably recognised by the University of Oxford, which has conferred upon him the distinction of Honorary M.A. Another of our contributors, Mr. A. Bernard Badger, B.A., of New College, Oxford, has added to the previous honours won by him at the same University. Last year he was placed in the First Class of the Final School of Natural Science after an examination in Morphology (Comparative Anatomy). This year he has again been placed in the First Class of the same Final School after an examination in Geology, thus achieving the distinction of a Double First Class. He has also during the present year been elected to a Burdett-Coutts (University) Scholarship, which is given "for the promotion of the study of Geology and of Natural Science as bearing on Geology." The following are some of the eminent men who have been Burdett-Coutts Scholars: Professor W. Boyd Dawkins, F.R.S. (1861), Professor E. Ray Lankester, F.R.S. (1869), and Mr. E. B. Poulton, F.R.S. (1878).

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION.—Thursday, May 23rd. Mr. W. R. Hughes, F.L.S., in the chair. Miss Byett gave her exposition of the XVII. chap. of Herbert Spencer's "First Principles," entitled "Equilibration."—Tuesday, May 28th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Bagnall exhibited, for Miss J. R. Gingell, *Polygonatum officinale*, *Convallaria majalis*, *Neottia Nidus avis*, *Habenaria bifolia*, *Cardamine pratensis* with double flowers, and *Paris quadrifolia*, showing variations in the number of floral leaves. Mr. W. B. Grove exhibited, for Mr. Wilkinson, *Trichobasis scillarum*, from the Lickey Hills. Mr. Hughes read his paper on "A Trip to Dickens's Land," which gave

an account of the home of Chas. Dickens, Gadshill Place, Higham, by Rochester, Kent, describing its geological, historical, and picturesque aspects, and especially its present condition, which is practically unchanged since the death of the great novelist, owing to the admirable manner in which it has been kept up by its present owner, Major Austin F. Budden.—Microscopical Section, June 4th. The President in the chair. Mr. W. B. Grove, M.A., exhibited *Ustilago hypodytes*, on culms of *Elymus arenarius*, from the shore at St. Andrews, N.B.; Mr. T. E. Bolton, living specimens, under the microscope, of *Trichophrya epistylidis* and *Leptodora hyalina*; Mr. W. H. Wilkinson exhibited some rare lichens from Dr. Stirton, of Glasgow: *Usnea longissima*, *Roccella fuciformis* var. *Montagnei*, in fruit; *Parmelia hottentotta*, *Parmelia Kamtschadalis*, and *Endocarpon Moulinsii*, from India; *Parmelia Millaniana*, from Scotland; and *Lecanora homologa*, from New Zealand; also a section of the latter under the microscope, showing the peculiar three or five locular spores. A paper by Mr. E. W. Burgess on "The Pocket Dredge for Microscopic Objects, &c.," was then read by Mr. W. P. Marshall, M.I.C.E., which will appear in the "Midland Naturalist." Mr. Marshall stated that the proposed dredge was similar to one in use by the society, except in being open at the bottom, and in the first four feet of rope being of wire, in front of the dredge, to prevent abrasion by dragging on the ground. A discussion upon its merits took place in which the President, Messrs. Goode, Reading and others took part. A vote of thanks to Mr. Burgess was passed, a copy of which was to be forwarded to him.—Sociological Section.—Thursday, June 6th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Browett gave his exposition of the XXIII. chap. of Herbert Spencer's "First Principles," entitled "Dissolution."—Geological Section, June 18th. Mr. T. H. Waller in the chair. Exhibits:—Mr. W. B. Grove, 1, *Polyporus elegans*, from the slopes of Scaw Fell, near Wastwater; 2, *Puccinia Betonicæ*, from Rosthwaite, Borrowdale. Mr. A. Browett, 1, *Polygala vulgaris*, common milkwort, from Buxton; 2, *Sanguisorba officinalis* (Great Burnet), from Harborne Fields. Mr. W. H. Wilkinson, *Clianthus pulchellus*, sometimes called the crab's claw, and at other times the parrot's beak, from the shape and colour of the rich red blossoms. These blossoms were gathered from a climbing plant growing out of doors in North Devon. Mr. Herbert Stone, Nidus of a spider, *Epëira fusca*, from Sherwood Forest. Mr. Jno. Udall, various hand specimens of rocks from Colwyn Bay. Mr. Waller read a paper on "Picrites," and illustrated it by some very choice hand specimens and micro-sections. A hearty vote of thanks was accorded.—Sociological Section.—Supplementary Meeting, June 20th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Hughes announced that he had received a number of communications from the Brooklyn Ethical Association, including copies of the following documents:—A resolution passed by them thanking Mr. Herbert Spencer for his assistance and advice to them when forming the association, and congratulating him on his improvement in health. A letter to M. Grosclande, of Paris, on the progress of philosophy in America, and the address of their President at the conclusion of their first session. Also a letter of thanks to the members of the Sociological Section for their congratulatory resolution recently sent them. Mr. Hughes proposed, and Mr. Grove seconded, "that the letter be entered upon the minutes." It was also resolved "that the whole of the correspondence be left in the hands of the President, Mr. Kineton Parkes, and Mr. Herbert Stone for the purpose of giving it publicity." Mr. W. B. Grove, M.A., gave his address on the "First Principles" of

Herbert Spencer, being a summary and conclusion of the same. He said that this work, the study of the second part of which the Section had just concluded, was a superstructure erected upon the one datum, the "Persistence of Force," which he understood to mean that no effect was conceivable without a cause, and conversely that no cause was conceivable without its effect. He then proceeded to trace the development of the various phases of Evolution as set forth in "First Principles," and showed how they followed from the primary assumption. The lecturer laid particular stress on the fact that people in general overlooked the process of Dissolution, which rhythmically alternates with the upward movement of Evolution, and that, when Being arrives at a state of complete equilibrium, owing to the continued redistribution of motion, Dissolution will then commence, and continue until it reaches perfection, when Evolution once more will take place.

OXFORDSHIRE NATURAL HISTORY SOCIETY.—Tuesday, May 28th. The President in the chair. Mr. F. Gotch, M.A., gave a lecture on the "Electric Organ in Fishes." It was profusely illustrated with specimens, both dried and in spirits and also microscopical, by diagrams, and by lantern slides on the screen. The lecturer said that, like first-class and second-class men-of-war, there were first-class and second-class electric fishes. The three "first rates" known were the torpedo, a native of the Mediterranean, Bay of Biscay, Red Sea, and elsewhere; and two fresh water fishes, the electric eel of the Amazons and the electric barbel of the Nile. The common skate of our own shores was a "second rate" electric fish. He first gave a history of the torpedo and Nile electric barbel as known to the ancients. They were of opinion that the shock given by these creatures was a sudden frost or intense cold, sent forth at will. The electric barbel appeared in Egyptian hieroglyphics—unmistakeable from its very long barbels and antennæ. The *electric* power of these fishes was first discovered by a French physician who lived in the Isle of Rhé. That the shock was indeed due to electricity was scouted as "impossible" by the English savants of the time, but the fact was soon conclusively proved by ingenious experiments. In the torpedo the electric battery consisted of four masses of short hexagonal columns, two at the head and two at the tail, the pair at the head being much the larger. In the eel about seven-eighths of the entire length of the fish were taken up by the battery, which lay on each side of the spine, only about one-eighth at the head being occupied by the digestive organs. These eels sometimes attained a length of seven feet or more. The barbel was quite a small fish, six to nine inches long, but very powerful, and a great deal of its body was taken up by its batteries. After briefly explaining the action of the electric current in the voltaic "pile," Mr. Gotch described the minute structure of the batteries of these fishes. They were made up of what were in fact "voltaic piles," each column being one pile, consisting, as in the piles which we make, of plates with differing surfaces laid one on another. In the skate there were only sixty or seventy plates to the inch; in the Nile barbel some 500. The electric power of the fish partly depended on the number of its plates to the inch, and partly on the number of successive shocks which it could give in a second; the more plates and the more impulses, the greater the power. The plates were excited by the brain power of the fish; it only gave a shock "when it was minded" to do so. The shock given by the skate was very feeble—hardly perceptible to our senses—but a powerful torpedo, which would transmit from 105 to 130 impulses *per second*, would give a man such a shock as to disable his arm or leg for the rest of the

day. And even a baby torpedo, no bigger than half-a-crown, gave him (Mr. Gotch) such a shock on the hand that he was obliged to drop it. Speaking of the uses of this electric power, he believed that in all three fishes it was used for defence, and in at least the two fresh-water kinds for offence also. Salt water was a hundred times a better conductor of electricity than fresh water. Consequently a shock was sooner dissipated in it, and so would be felt less by an animal at a little distance, while in fresh water the shock would travel further, and so be felt more by surrounding fishes. The torpedo gave a very severe shock to anything in contact with it; but the electric eel could shock things at a little distance quite as severely. And so the power of the torpedo, while quite as useful for defence as that of the fresh-water eel, would not serve so well for offensive purposes. That the eel does use its power for attack, he knew, because he had seen the one at the Zoological Gardens feed in this way. By putting its nose to its tail it completed the circuit, and sent a shock through the water, temporarily paralysing all the sticklebacks in the tank. Then (it was a very sluggish fish) it eat as many as it wanted, while the others gradually recovered and were ready for its next meal. Mr. Gotch concluded by relating an amusing story of the way in which the electric barbel feeds. One of these and a fish which was non-electric were kept in the same tank. The non-electric fish had an enormous appetite for worms and other things, but the electric barbel would never touch even a wormlet, yet it seemed in good health and condition. Observation revealed the fact that the non-electric fish *ate for two.* Always after a full meal the barbel would swim gently over him, and whisk his barbels and antennæ against him, thus effecting an electric discharge. The non-electric fish straightway disgorged his worms, which the electrician immediately ate. One day, alas, he shocked his friend too much, so that he died of it, and the electric barbel, being unable or unwilling to eat fresh worms, soon pined away and died too. Mr. G. C. Druce showed fresh specimens of the bird's nest orchis and the small helleborine, both found in the neighbourhood, and Mr. M. S. Pembrey exhibited a "thrush's anvil" (*i.e.*, the stone on which the bird cracked his snails), and some of the broken snail shells.—Tuesday, June 4th. Excursion to Stanton Harcourt. Nineteen members and friends drove through Cumnor to Bablock Hythe Ferry, where a little botany and ornithology was done. At Stanton Harcourt they saw Mr. Arnatt's collection of birds, and went over the old Harcourt House, *i.e.*, the Church, Pope's Tower, and the Abbey Kitchen. On the way home some dozens of the Painted Lady butterfly were seen flying in the sunshine, just before sunset, like moths.—Tuesday, June 11th. The Rev. J. W. B. Bell, vice-president, in the chair. There were two lectures this evening—one by Professor J. Westwood, M.A., on "Stingless Bees and Irregularly-shaped Honey Pots," and the second by Mr. O. H. Latter, on the "Life History of the River Mussel." Professor Westwood described these curious little bees from Borneo, and showed the peculiarities of their honeycombs. Mr. Latter gave the results of his observations as far as he had at present worked out the life history of the mussel. Although he could not yet give the complete cycle, he related some very curious facts concerning the development of the embryos and the structure of the gill plates, which are used not for breathing only, but also in the shelter of the young. This meeting concludes the series of indoor meetings for the season.

ERRATUM.

Page 135, line 11, "Quarterly Review" should be "British Quarterly Review."

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

We have great pleasure in publishing the following excellent programme, arranged by the Oxford Natural History Society for the forthcoming meeting of the Union. We urge all members who intend being present at the Oxford meeting to send in their names without delay to Mr. Underhill, whose address will be found in the programme.

PRELIMINARY PROGRAMME.

Meetings at Oxford, Monday and Tuesday, September 23rd and 24th, 1889.

President:—Mr. E. B. POULTON, M.A., F.R.S.

The Oxford Society cordially invites members of Natural History Societies and their friends to the meetings of the Union. The following is the preliminary programme :—

Monday, September 23rd.

1.45 p.m. Meet at the University Museum in the Parks.
2 to 3.30 p.m. Members of the Oxford Society will conduct parties of visitors over Oxford.
3.30 p.m. to 4.30 p.m. Afternoon Tea in the Museum.
4.30 to 6 p.m. Inaugural Address on "Heredity" from the President, Mr. E. B. Poulton, M.A., F.R.S., to be followed by a discussion.
8 to 11 p.m. CONVERSAZIONE IN THE MUSEUM.

Every effort will be used to make this soirée one of great interest, and a full programme will be printed on the tickets for the meetings, and also (it is hoped) in the September number of the "Midland Naturalist."

Tuesday, September 24th.

9.30 to 12.30. Drive to Shotover Hill and Lecture by the President on "The Geology of the District."
1 to 2 p.m. Lunch in Christ Church Dining Hall.
2 to 6 p.m. Special arrangements will be made both on this and on Monday afternoons for visiting the Museum, Ashmolean, Radcliffe Observatory, Botanic Gardens, Bodleian Library, and Clarendon Printing Press.

The tickets for the meetings will be 10/6 each. There will be no extras. Those who intend to visit Oxford are requested to write to the Secretary, Mr. H. M. J. Underhill, 7, High Street, Oxford, as soon as possible.

The Oxford Society will provide entertainment for as many visitors as they can, and this hospitality will be allotted

to visitors according to the order in which their application for tickets is received.

For those who prefer it, or who cannot be entertained, information concerning lodgings and hotels may be had on application to the Secretary.

The Secretary will be glad to receive communications from any members who have interesting exhibits to show at the conversazione.

H. M. J. Underhill,
Secretary of Oxford Natural History Society.
7, High Street, Oxford.

THE PETROLOGY OF OUR LOCAL PEBBLES.*

BY T. H. WALLER, B.A., B.SC.

The great pebble beds of the district round Birmingham are probably familiar to all the members of this Society, to many of them far more so than they are to myself. My opportunities for collecting specimens from them have been very few and far between, and as I am not likely to be able to give much more time and attention to the subject in the future than in the past, it seemed as if a sort of interim report on the petrology of the pebbles might be of service in stimulating to a closer study of the deposits some who can give more time to the matter than is possible for myself.

At any rate, whatever we know of the gravel and pebble pits, and the occurrence of the pebbles *in situ*, we all know the general appearance of the component pebbles. Many of us no doubt have examined them a little more closely, and have observed that by far the larger number are composed of some form of quartzite, and it is some of these quartzite pebbles that have furnished to the minute search of several indefatigable workers amongst us (Messrs. Harrison, Evans, and others) those rare and proportionably valuable fossils to which we must look to indicate the geological horizon of the rock masses from which the fragments were torn, which, after the rough knocking about which has rounded them, and smoothed—indeed, in many cases almost polished—them, went to make up the great formation of the Bunter pebble beds.

Professor Lapworth has indicated, in the lecture to which we listened with such pleasure and profit some six months

* Read before the Birmingham Natural History and Microscopical Society, 19th March, 1889.

ago, the physical conditions in which, judging by the analogy of what is going on at the present time, these beds accumulated: he has pictured to us the mountain torrents bringing down their loads of stones from the interior of the great mountain ranges, and depositing them where they emerge from the mountains on to plains, where the fall of the ground was insufficient to produce the current necessary to carry the burden further. In this transportation it is plain that a very powerful process of selection would go on. The harder rocks would evidently be those which would be the fittest to survive, and we all know that these pebbles are about as tough and intractable as any stones we have to do with.

Now the quartzite composing the pebbles is certainly in great part very different from any rock which at present appears at the surface in the Midlands, or indeed for very long distances from us. We have quartzite formations at the Lickey, Nuneaton, the Wrekin, and further off in the borderland of Shropshire and Wales; but, so far as I know, these would only furnish *one* of the types of rock which we find in the pebble beds. Of the other types which, from their structure, cannot, I think, have been mere local variations in a quartzite mass, the present exposures afford no examples.

The origin of the pebbles—the direction in which they have been brought into the district—has been vigorously discussed, and is at the present time quite unsettled.

Professor Bonney has minutely examined the formation principally in the area of Cannock Chase, and believes that great rivers or shore currents brought the stones from the North, even finding parallels for some of the rocks in the Torridon sandstone of the far Northern Highlands. It has been objected to this view that the pebble beds attain their maximum of thickness and of richness in pebbles about the district of Cannock Chase, where they reach a thickness of 300 feet; while, as they are traced further north towards Nottinghamshire on the one hand, or Liverpool on the other, the pebbles become fewer and ultimately disappear, the rock becoming first a pebbly sandstone, then a sandstone with occasional pebbles. Further north still, in Yorkshire, they are altogether wanting, the lower mottled sandstone being the only representative of the Bunter, while at Carlisle the Keuper beds are the only representatives of the Triassic strata.

I have taken the above summary from the important paper read by Mr. W. J. Harrison to the Philosophical Society in this city in 1882, on the derivation of the quartzite pebbles of the Drift and the Triassic strata. In this paper he shows reasons for believing that the pebbles came from the west.

He points out that the lines of false bedding of the Bunter beds indicate almost invariably currents sweeping from the west or north-west, and quotes Mr. Sorby's observation that, in examining a large number of specimens of New Red Sandstone from various localities lying in a north and south line from Scotland to Devonshire, "what struck me most was the comparatively uniform extent of the wearing," inferring that "we cross the line of drifting transversely from north to south." The fossiliferous pebbles do not seem at present to throw much light on the situation of the parent rock.

The celebrated pebble bed of Budleigh Salterton, of Lower Keuper age, has been very carefully examined for some years, and the fossils found in the quartzites there are such as are contained in no British rock; while across the Channel, in Normandy and Brittany, Silurian and Devonian quartzites with similar fossils do occur. The Devonshire geologists have, says Mr. Harrison, located the home of their travelled quartzites under the water of the English Channel, and it is probable that most of the rocks which furnished the Midland pebbles now lie beneath a mass of newer strata by which they are covered over and concealed.

Into the question of the fossil contents of the stones I am quite unable to enter; but I owe many specimens to the kindness of Mr. A. T. Evans, who, while engaged in what must be the wearying search for organic remains, has collected examples of other rocks, which I have thus been able to examine. These are mostly from the King's Heath pit and from Sutton Coldfield. I have collected a considerable number of specimens from Sutton and from the Alvechurch district, although I should be inclined, for reasons to be stated later, to consider most of these as forming the glacial rewash of the Bunter beds with some admixture of rocks of which the place of origin is much less obscure.

As such a large majority of the pebbles are quartzite, it will, perhaps, be best to consider these first in somewhat of detail. These I have studied principally from Sutton specimens, particularly from the pit by Blackroot Pool. At this pit the pebbles are often cracked in a very peculiar manner; all the planes of fracture lie vertically, or nearly so, in the natural face of the digging, and occasionally they are seen to originate in two pebbles at the points at which the two are in contact. When this is the case, it is not the side contacts, but the vertical ones, from which the cracks start. I hence conclude that the pressure which has cracked the pebbles was exerted in a vertical direction, driving them against each other.

Another curious thing may also be observed in the same pit, namely, hollows in the sand, which, on careful examination, are found to have the usual ovoid shape of the pebbles of the bed, but to contain only a few internal casts of shells or encrinite stalks lying loose in the hollow, showing that the cavity was originally occupied by a pebble of limestone, which has been dissolved out by the carbonic acid contained in the water which has percolated through the mass since its deposition. I should think also that it is evidence that the crush which has cracked the pebbles took place at a comparatively early epoch of their existence, as we might expect an empty space to be disturbed by such a pressure. In a cutting on the Midland Railway to Walsall, a short distance to the west of this place, I observed, during the construction of the line, a multitude of small faults (with throws of from an inch or so to a foot) extending over about half a mile. Every now and then one could be met with of more considerable throw, say two or three feet, and the pebbles were all perfectly crumbly under the hammer, seeming perfect outwardly, but simply falling to pieces at the slightest tap; a circumstance which had been of great annoyance to the contractors for the line, as they had looked to this stretch of gravel for ballasting purposes.

Of the quartzites we recognise several varieties. One is pure, dense, white, with a fracture crystalline and glistening almost like loaf-sugar; another is almost black, another honey-yellow, another banded. We find occasional examples also of a less solid-looking rock, more like that of the Lickey and Hartshill, and, among the quartz grains of this, bright pale green grains are observable. They are of a soft, earthy consistence, and of course totally disappear during the preparation of thin sections.

A somewhat closer observation of the principal varieties of quartzite, as they show themselves under the microscope, opens up several points of interest, and I will describe the main peculiarities of eight sections which I have made.

(1) A dark quartzite (1) from Sutton.

The component quartz grains are mostly angular and of moderate size, averaging ·005 to ·003 of an inch in diameter. They are cemented by a quartz which is in most parts cloudy and apparently dirty. Some of the original grains are also cloudy, with minute inclusions, while others are very pure and clear. The irregular clouding between crossed nicols due to strain by pressure is very common. In the quartz grains are contained many minute rounded granules with high double refraction, showing therefore in brilliant colours between

crossed nicols when the quartz grain in which they are contained is in the position for extinction. A considerable number of flakes of a white mica lie among the quartz grains, but do not appear to belong to the original quartz, as they do not traverse the grains. Rounded grains of zircon, or at any rate of a mineral of very high refractive index, and of a white or pink, some even of darkish pink colour, occur pretty frequently in the quartz; and a few fragments of tourmaline, showing the characteristic dichroism, are scattered throughout the section. Only very few grains of felspar are recognisable; one shows multiple twinning.

(To be continued.)

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.

BY W. B. GROVE, M.A.

(Concluded from page 141.)

The surfaces of all plants, the feathers of birds, the skins of animals, the human face, hair, hands, and garments, are all covered with Bacteria, or their spores, that have fallen upon them from the air. The ground itself receives, of course, the greatest number, and yet it is found by actual cultivation that the Bacteria of the soil are not entirely identical with those of the atmosphere. In the air, Miquel found by experiment that five kinds are always present, although he appeared to be incapable of deciding what those kinds are, with the exception of *Cladothrix dichotoma*.

In the soil the Bacteria are confined to the superficial layers; at a depth of 2ft. hardly any are found, and at a depth of 3ft. none. If particles of soil are crushed fine, and then sown on the surface of solid nutrient gelatine, as was done by Koch, we see the Bacteria which were in the soil develop in a number of little colonies. By this means Miquel has calculated that there exist in a grain of soil of the Park of Montsouris, on the average, 50,000 bacterial germs, and in the streets of Paris between 100,000 and 150,000. Adametz found in a grain of ordinary garden soil about 30,000. These are chiefly the putrefactive and fermentative Bacteria, but the pathogenic (disease-producing) species can also occur in the earth; when sheep that have died of anthrax are buried, the soil is permeated with the spores, which are conveyed to the surface by earthworms,

and thus infect with the disease the flocks which may be feeding on that spot.

Certain kinds of Bacteria that are found in soil are believed by many observers to have a very important effect upon it from an agricultural point of view. This is especially true of some species of Micrococci ; one, *Micrococcus nitrificans*, was so named because it was supposed to be the especial seat of this power, by which the ammonia, or even the free nitrogen, in the interstices of the soil was oxidised with the formation of useful nitrates. Another species, *M. cereus*, has also been described as a "very efficacious nitrifying agent." But considerable doubt has been thrown upon this belief by two other alleged facts : (1) That the nitrifying action goes on in soil in which no Bacteria can be detected, and (2) that "pure" cultures of some of the species said to produce this effect exhibit no trace of the power. Others have attributed the chemical action to the soil itself, which is supposed to act like spongy platinum, and condense the gases in its interstices. Moreover, there seems to be equal proof that some microbes can denitrify, decomposing nitrates and evolving ammonia or free nitrogen. It may be that in both cases the action is merely an inorganic one, and that the Micrococci are only accidental accompaniments of the process ; or it may be that the very same organisms can nitrify or denitrify, according to circumstances.

Since the lower strata of the soil contain no Bacteria we should expect that pure uncontaminated cold spring water, coming from a sufficient depth, would also contain few or none. This may be proved by spreading a minute drop, taken directly from the source, on the surface of sterilised gelatine. In most cases no colonies will be developed. Deep well-water contains very few ; ten have been found in a cubic centimetre. Tap water shows from 57 to 1,950 per cubic centimetre ; but after rain the number increases. But the slightest exposure alters the condition of the water at once. From 50,000 to 100,000 have been found in a litre of water from a brook, and as the brook descends to the sea it rapidly becomes more contaminated.

Ordinary drinking water contains *Micrococcus aquatilis* and *Bacillus erythrosporus* in small numbers ; but if it remains standing, at ordinary temperatures (say 20° C.), rapid multiplication takes place. But there is a consolation in the following well-proved fact, that those species which propagate under such circumstances belong to the harmless kinds. Pathogenic Bacteria cannot live in ordinary spring water, but only if it contains decomposing organic matter. When introduced they never multiply, and after a time totally

disappear. A litre of rain water may contain 248,000 microbes; a litre of water from the Seine, at Bercy, has been shown to contain 4,800,000, and at Asnières 12,800,000; while water of impurer character showed the enormous total of 80,000,000 per litre. These numbers may, perhaps, be better comprehended if I say that they vary from 30,000 in a pint of brook water to 50,000,000 in a pint of the liquid which is called the Thames at London. Even ice contains many, especially if "bubbly"; the water derived from melted hailstones is often thronged. Prolonged freezing is no doubt fatal to the majority, but a temperature many degrees below freezing point is required to kill them all.

Of course, if the earth on which we grow our food, the air we breathe, and the water we drink are thus permeated by these countless numbers of microbes, it must needs follow that the human alimentary canal is full of them. They abound in the mouth, especially clustering round the teeth, and it is a remarkable fact that we can assert without a doubt that the species of Leptothrix, which is peculiar to this latter habitat, has always existed there; for Zopf and Miller discovered, isolated, mounted, and even stained, the Leptothrix from the teeth of Egyptian mummies. Nor is this antiquity all that can be proved of Bacteria. Far, far before this, in the dim light of carboniferous forests, *Bacillus Amylobacter* rioted in the decaying cells of plants as it does at the present day, and has left its traces behind in fossil leaves and stems, recognisable even after the lapse of so many ages by the exact similarity of its action to that which we now observe.

In the stomach, and especially in the intestines, the number of Bacteria enormously increases, and is greatest in the large intestine. It is not improbable that they play an important part in the digestion and assimilation of our food; this is certainly their function in the stomachs of herbivorous animals. But in the blood and in the healthy tissues of the body it is probable (according to the evidence of the best experimenters) that they are entirely absent. Those observers who think they have discovered signs of their presence there may have been misled by faulty methods of experiment, although it must not be forgotten that the presence of micro-parasites (not belonging, however, to the Bacteria) in the blood of healthy rats is an admitted fact. In any case, if any microbes are present in such places, they are only occasional intruders.

But this suggests the question—how are they kept out? The particles of chyle which are absorbed by the walls of the intestine are much larger than the Bacteria, and there is, therefore, so far, no reason why they should not be absorbed,

equally with the chyle, by the lacteal vessels, and thus carried into the general circulation. On the contrary, there is distinct evidence that they are so carried. The lymphatic tissue of the Peyer's glands of the intestine of perfectly healthy rabbits has been shown to contain numbers of Bacilli, and they are sometimes found in the amœboid cells of the blood. But there they are already dead; the putrefactive Bacteria of the intestine must be killed, nearly immediately, by contact with living cells.

This question of the fate of microbes in the blood of warm-blooded animals has been carefully investigated. Living saprophytic Bacteria of the following species:—*Bacillus subtilis*, *B. acidi-lactici*, *Micrococcus aquatilis*, *Spirillum tyrogenum*, were injected into the blood, and not a trace was visible after three hours. Even those which are pathogenic to man (but not to the animal experimented upon) disappeared in from three to four and a half hours, as *e.g.*, *Micrococcus tetragonus*, *Bacillus typhi-abdominalis*, *Spirillum choleræ-asiaticæ*, and *Streptococcus pyogenes*. It was proved also that their disappearance was not effected by excretion, either through the kidneys or the intestine, and the conclusion arrived at was that they were destroyed by contact with the *endothelial* cells.

We may compare the horde of microbes to an invading army of Goths or Vandals. The cells of the living tissue wage war against the intruders to defend their homes, and, if healthy, are always victorious. But if weakened from any cause they may succumb, and then the invading regiments seize upon the dead cell, multiply, and devour it ,and make of it a vantage ground for attacking the neighbouring cells. These dead cells may be absorbed into the circulation, and the Bacteria enclosed within them may be sufficiently protected from the hostile action of the blood to remain alive for some time; and if, during this time, they are carried to any part where disintegration or inflammation has set in, they may settle there, and find an appropriate nidus for their growth. We can thus account for the presence of certain kinds of microbes in diseased tissues within the body to which they could not have had, directly, any means of access.

But if the microbe which gains entrance to the body is a pathogenic organism to the animal in question, of course, the changes which take place are of a different character. Various kinds of bacterian diseases are produced, but into this topic, though it is of unsurpassable interest, I do not intend to enter, having considered the subject from the point of view, not of a physician, but of a cryptogamic botanist.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 163.)

Lees, in "Botany of the Malvern Hills."

* **Hypochœris glabra**, 38. In damp boggy spots about the base of the hills. *S.E. base of the North Hill, 1888, R. F. Towndrow. Sp.!*

H. radicata, 38.

Apargia hispida, 37.

A. autumnalis, 37.

Thrincia hirta, 37.

Picris hieracioides, 37.

Helminthia echioides, 37.

* **Tragopogon pratensis**, 37. Both forms.

Leontodon Taraxacum, 37. (*Taraxacum officinale and var. palustre.*)

* **Prenanthes** (*Lactuca*) **muralis**, 37.

Sonchus oleraceus, 37.

S. arvensis, 37.

Crepis tectorum, 37. *The plant intended is C. virens, L.*

Hieracium Pilosella, 37.

†* **H. murorum**. 37. Rocks near the Wych, 37. More luxuriant on Little Malvern Church. *I have previously expressed a doubt as to this being the true plant. It does not now grow at the Wych.*

* **H. vulgatum**, 37.

* **H. boreale**, 37.

* **Campanula rotundifolia**, 17.

* **C. patula**, 17. Ill.

* **C. Rapunculus**, 17. Near Bromsberrow.

* **C. latifolia**, 17.

* **C. Trachelium**, 17.

* **Vaccinium Myrtillus**, 21. On some eastern rocks of the Worcestershire Beacon, and in woods north of the End Hill. Ill.

* **Calluna vulgaris**, 21.

"N.B.—No species of Erica occurs throughout the chain."

* **Ligustrum vulgare**, 13. Mostly on the limestone strata. Ill.

* **Vinca minor**, 17. In a wood at the western base of the Keysend Hill; among underwood in the copse above the Lime Kilns at Leigh Sinton; also in a lane between Powick and Bransford. Ill.

* **Chlora perfoliata**, 21. W. Mostly on lime. Ill.

* **Gentiana Amarella**, 18. Abundant on calcareous soil on the western side of the hills, as near Purlieu Lane, below the Wych. Ill.

* **Cuscuta europæa**, 18. Among vetches at the Berrow, and at Cotheridge. Ill.

* **Solanum nigrum**, 18. Hanley.

* **Hyoscyamus niger**, 17. On waste ground at the Wells. Ill.

* **Verbascum Thapsus**, 17. A very conspicuous object in the Malvern Flora.

* **V. Blattaria**, 17. Occasionally by roadsides. Ill.

* **Antirrhinum majus**, 30. On old walls. Ill.

* **A. Orontium**, 30. Not very common. E. Ill.

* **Linaria Cymbalaria**, 30. Walls. Ill.

* **L. spuria**, 30. Corn fields at the Croft Farm, Mathon.

* **L. Elatine**, 31. With the last; also in fallow fields at Bushley.

* **L. vulgaris**, 31. Common.

L. minor, 31. On the borders of fields about the Croft Lime Works, Mathon.

* **Veronica hederifolia**, 14.

V. polita, 14.

V. agrestis, 14.

V. arvensis, 14.

* **V. serpyllifolia**, 14.

* **V. officinalis**, 14.

* **V. Chamædrys**, 14.

* **V. montana**, 14. Ill.

* **V. scutellata**, 14. Ill.

* **V. Anagallis**, 14. Ill.

* **V. Beccabunga**, 14.

* **Melampyrum pratense**, 30. Woods. And var. **montanum**.

* **Lathræa squamaria**, 30. Bridges Stone Mill; Purlieu Lane; Holly Lodge Grounds, Great Malvern; near White House, Berrow. Ill.

* **Orobanche major**, 31. Eastern base of Herefordshire Beacon, Hollybush Hill, and near the Wells. Ill.

† **O. elatior**, 31. From a clover field below the Abbey Church, Great Malvern. Miss Moseley's Herbarium. *This record cannot be regarded as free from doubt, as O. elatior is parasitical on Centaurea Scabiosa.*

* **Verbena officinalis**, 31. About Hanley, &c. Ill.

* **Mentha rotundifolia**, 29. Not nearer than Sapey Brook, Knightwick.

* **M. viridis**, 29. On the side of a deep ditch below the Link, some years ago.

* **M. Piperita**, 29. Plentiful on Welland Common. Ill.

M. hirsuta, 29.

* M. gentilis, 29. Teme side, Powick Weir.

* M. arvensis, 29.

* M. Pulegium, 29. On Barnard's Green according to W. Addison, Esq.

Thymus Serpyllum, 29. H.

Clinopodium vulgare, 30. (*Calamintha Clinopodium.*)

* Calamintha officinalis, 30. (*C. menthifolia.*) About the eastern base of the hills. Ill.

Melissa officinalis, 30. Hanley, near Farm Houses; naturalised.

* Nepeta Cataria, 29. Near the Wind's Point. Ill.

* Salvia Verbenaca, 14. Marl banks. E. Ill.

* Scutellaria galericulata, 30. By the side of Danemoor Pool, Welland Common, and by ponds on Barnard's Green. Ill.

* Marrubium vulgare, 30. About Welland and Castle Morton Commons. Ill.

Stachys sylvatica, 29.

S. palustris, 29.

* S. arvensis, 29.

Lamium amplexicaule, 29.

incisum, 29.

purpureum, 29.

album, 29.

* Lithospermum officinale, 16. Ill.

L. arvense, 16.

Myosotis palustris, 16.

* sylvatica, 16.

* collina, 16.

Lycopsis arvensis, 16.

* Anchusa sempervirens, 16. In a shrubbery near Mathon Lodge. Ill.

* Borago officinalis, 16. Ill.

* Symphytum officinale, 16. Watery meadows.

* Cynoglossum officinale, 16.

* C. sylvaticum, 16. At the eastern base of the Warren Hill, near the "Gullet." Also by the side of the road near Longdon Church.

* Pinguicula vulgaris, 14. Bog at the western base of the Worcestershire Beacon. Ill.

Utricularia vulgaris, 14. Pools. E. Rare. In the 3rd Edition the locality is given as near Chaceley.

* Hottonia palustris, 17. Only at Forthampton, south of Longdon, in a ditch near Mr. Yorke's, Forthampton Court. Forthampton is in Gloucester. Ill.

* Lysimachia vulgaris, 17. Longdon Marshes. Also by the weir at Powick Bridge on the Teme. Ill.

* Anagallis cærulea, 16. In cornfields by the Croft Limeworks in 1841. Ill.

A. tenella, 16. Abundant in the bog at western base of Worcestershire Beacon. Ill.

‡ Centunculus minimus, 15. Rare. H. Base of the hills near Brand Lodge. *This locality is in Herefordshire. The previous record in the "New Botanists' Guide," where no locality is given, see ante, "Midland Naturalist," Vol. XI., p. 279, probably refers to the same habitat.*

* Samolus Valerandi, 17. E. Ill.

* Plantago media, 15.

* P. Coronopus, 15. E. Ill.

* Chenopodium polyspermum, 20.

C. album, 20.

* C. urbicum, 20.

* C. rubrum, 20.

C. botryoides, 20.

* C. B. Henricus, 20.

Atriplex patula, 42. A synonym of the following.

* A. angustifolia, 42.

Rumex sanguineus, 21. *This is the form R. viridis, see Edition 2, p. 43.*

* R. maritimus, 21. Chalybeate Pool and Longdon Marsh.

* R. palustris, 21. *In the 2nd Edition the localities are stated as "Forthampton and Severn Stoke;"* in the 3rd Edition as wet spots near Forthampton. Ill.

R. acutus, 21. *A misnomer. Omitted in the 2nd and 3rd Editions.*

R. obtusifolius, 21.

R. pratensis, 21. *In the 2nd Edition the locality is given as "Longdon."*

R. crispus, 21.

* R. Hydrolapathum, 21. Longdon.

R. Acetosa, 21.

R. Acetosella, 21.

Polygonum Convolvulus, 21.

† P. dumetorum, 21. *In the 3rd Edition this name is queried.* Mr. Lees adds: "*I found either this, or a very tall variety of the preceding, in a hedge bounding Saru Hill Wood, Bushley, some years ago, when residing at Forthampton." Almost certainly P. Convolvulus var. pseudo-dumetorum, Watson. The true P. dumetorum is a plant of the south of England.*

P. aviculare, 21.

* P. Hydropiper, 21.

* P. minus, 21. In damp depressions of the wet commons, eastward.

* P. Persicaria, 21.

P. lapathifolium, 21.

P. amphibium, 21.

* P. Bistorta, 21. Ill.

* Daphne Laureola, 21. Woods.

Euphorbia Helioscopia, 40.

* E. amygdaloides, 40.

* E. Peplus, 40.

E. exigua, 40.

* Ceratophyllum demersum, 40. Longdon Marsh.

C. submersum, 40. Pools on Welland Common.

* Parietaria officinalis, 15. Little Malvern. Ill.

Urtica dioica, 40.

U. urens, 40.

* Humulus Lupulus, 42.

* Quercus Robur, 40, and vars. intermedia and sessiliflora. *Intermedia at Cowleigh Park in Herefordshire.*

"The Beech," Mr. Lees observes. "I have never observed growing wild in the district, but it is planted here and there." 3rd Edition, p. 97.

* Corylus Avellana, 41.

* Alnus glutinosa, 40.

Salix pentandra, 41. Teme side, Powick.

S. fragilis, 41.

S. decipiens, 41. Var. of *S. fragilis.*

* S. Russelliana, 41. Var. of *S. fragilis.*

S. alba, 41.

* S. vitellina, 41. Var. of *S. alba.*

S. undulata, 41.

S. triandra, 41.

* S. amygdalina, 41. Var. of *S. triandra.*

* S. purpurea, 41.

S. viminalis, 41.

S. Smithiana, 41.

* S. cinerea, 41, with vars. aquatica and oleifolia. *First record for var. aquatica.*

* S. aurita, 41.

S. caprea, 41.

* Juniperus communis, 42. Edges of woods near the Croft, Mathon. Ill.

* Taxus baccata, 42. On the Hollybush Hill, and in the woods on the calcareous soil on the western side of the hills.

(*To be continued.*)

THE BATH OOLITE AND METHOD OF QUARRYING IT.*

BY ALFRED BROWETT.

At the recent meeting of the British Association at Bath, joining the excursion to Box and Corsham Down Quarries, one of the largest workings where the celebrated Bath Stone is obtained, and seeing how largely this stone enters into the building of our houses, it occurred to me that some brief account of when and how it was formed and how it is now got would not be uninteresting to the members of the Geological Section.

It is probably known to all of you that the freestone beds supplying this stone constitute the Great or Bath Oolite of the Lower Oolite Series of the Jurassic System. The rocks of the Jurassic group appear to be always of marine origin, and to have been formed at a time when sea waves rolled over the Middle and South of England. They were formed long subsequent to the coal formation, but still so long ago that not only have vast changes since taken place on our earth's surface, but the types of both plants and animals have many times changed, and not a single species then existing is now to be found.

Oolite is a granular limestone, and the grains of which it is composed are egg-shaped, and in mass resemble the eggs or roe of a fish ; hence the name, from the Greek ᾠόν an egg and λίθος a stone. When these eggs or grains are very distinct, it is called Roestone, and when they are large and pea-like, it is called Pisolite or Peastone. These little grains consist of carbonate of lime arranged in successive concentric layers, like the coats of an onion, round some minute particle of foreign matter which forms a nucleus, it may be of sand or a minute fragment of coral or any such substance. Some Oolites consist only of these spheroidal grains, and are compacted by pressure ; in others the interstices are filled up by fine-grained calcareous mud ; others are cemented by an infiltration of crystalline calcite.

The quarries whence the stone is obtained might be more correctly termed mines, the workings being entirely underground, forming tunnels several miles in length, branching

* Read before the Geological Section of the Birmingham Natural History Society, on Tuesday, November 20th, 1888.

out in all directions. They are consequently subject to the Metalliferous Mines Regulation Act. They are cleaner than coal mines, and the ways are somewhat wider and loftier, but in other respects they are so much alike that at first it was difficult to realise that we were not in a South Staffordshire mine. There are, however, no gases evolved in stone as in coal mines, hence the air is much purer, and in these particular mines it is very good. The temperature stands at about 55° Fahr. all the year round, and so is specially suitable for physical labour, being neither too hot nor too cold.

On arrival at the entrance to the quarries all the men of our party, numbering about one hundred, were furnished with petroline hand lamps, all clean and freshly-trimmed, and provided new for the occasion by the kindness and considera-tion of the Bath Stone Firms, Limited. These made a fairly effective illumination, and enabled everything of interest in the galleries and chambers to be readily seen. The entrance is not by pit shafts as in most mines, but by inclined planes, more or less steep, the steeper ones flanked by steps. Down these are laid tramways to a 2ft. 6in. gauge, which traverse the whole of the workings. These tramlines enable the blocks of stone, when it is not necessary to keep them in the mine for a time for seasoning, to be placed at once on a trolley as soon as craned from their bed, and drawn direct from the mine to the wharf or railway station, and straight-way loaded on to the railway truck.

The method of quarrying the stone is as follows:—The first thing to be done is to pick out close to the ceiling, or along the top of the uppermost layer of marketable stone, a horizontal groove from 6 to 12 inches in height, to the depth of, or running back from the face, about 5 feet, and extending the full width of the adit or working. This groove is holed with three successive picks. The first a large and heavy one with a short handle, the next a smaller pick with a longer handle, and, finally, a small light sharp pick with a handle which appeared to be some 6 or 7 feet in length, to enable the workman to work back to the full 5ft. This, after a little experience, the workman is readily able to do, as the stone, especially while *in situ*, is somewhat soft and friable. This admits of a saw being placed on edge in the groove, by means of which a man standing in front of the rock makes a vertical saw-cut at right angles to the groove down through the rock to the natural parting at the bottom of the first layer. This cut is in a right line from the front to the back of the groove. Another saw-cut is then made at a distance of about 5ft., but this is pointed in such a

direction that the block of stone which lies between the two cuts is narrower by about 6in. at the back than at the front. It is cut into this wedge shape so as to be more readily drawn out at the face of the rock by means of the crane. Wedges are now driven into the natural parting at the bottom of this taper piece of stone, until the stone is burst off at the back. It is then, sometimes by means of crowbars, prized forward sufficiently to admit of a chain being passed round the wide end of it, or more frequently, and as was the case with the block quarried in our presence, a lewis is inserted in the front of it. In either case the chain is attached to the crane, and the first piece of stone is thus drawn out from its position, and loaded on a trolley for removal as before described, leaving a hole in the rock large enough for a man to get into.

After the first block is out the work is easier. A man now goes to the far end of the hole, and, looking sideways, passes a saw into the groove, makes a vertical saw-cut down the back as well as down the remaining side ; thus the second piece of stone is detached on all sides as on the top, and easily drawn out from the rock. By a repetition of this process, and, of course, leaving sufficient pillars to carry the roof, the excavating of the upper beds is carried on to any extent.

The lower beds are detached by sawing only, there being no difficulty in starting a saw-cut on any of the surfaces. No explosives are used, the stone being soft enough, especially before it is seasoned, for everything to be done with pick, saw, and wedge. The saws used have large teeth, and are of a shape specially adapted for the work they have to perform, and are somewhat peculiar in appearance, having a long strong handle set at right angles to the saw.

The blocks of stone, as they are drawn out, are scappled to a proper shape, and all defective parts are removed. Each block is carefully inspected by at least two experienced foremen. The absence of metallic ring on its being struck by a hammer indicates an internal flaw, which has to be looked to and got rid of by cutting a large block into a smaller or into two smaller ones. Finally, every block is measured, marked, and numbered, then drawn by horse or steam power to the quarry mouth, and run down the tramways to the railway station.

To give some idea of the extent of these mines, we entered underground in Box Parish and emerged in Corsham Parish, having in the meantime traversed several miles of underground workings, occupying over two hours in doing so.

Though the Oolitic rocks stretch right across England from Dorsetshire to Yorkshire, it must not be supposed that Bath freestone is to be got all through the series. Good

workable stone is to be found only within an area of some thirty miles long by about ten miles broad, extending to the east of Bath between Chippenham on the north and Trowbridge on the south. The thickness of the stone also varies considerably. At Box Hill, where it is believed to reach its maximum, it is about 45ft., comprising 12ft. to 15ft. scallet or finest grained, cut for ashlar or facing purposes, 15ft. to 20ft. corn grit, used for dressings, and 16ft. to 22ft. ground stone ; while at Combe Down, only a few miles distant, the total thickness is but about 7ft.

A characteristic of the stone may be mentioned : it is very light, its specific gravity when dry being but a shade over 2, while the generality of rocks forming the earth's crust average from $2\frac{1}{2}$ to $3\frac{1}{2}$ times the weight of water. One hundred pounds of dry stone will absorb only nine pounds of water, and a sound block will stand a pressure of seventy tons on the square foot without cracking.

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, M.A., AND J. E. BAGNALL, A.L.S.

(Continued from page 137.)

Sub-genus XXI.—Hebeloma.

214. **Ag. fastibilis**, *Fr.* Woods. Oct. The Spring; Crackley Wood, Kenilworth, *Russell, Illustr.* The Moats, Ansty, *Adams.* Sutton ; Sutton Park ; Trickley Coppice.
215. **Ag. testaceus**, *Batsch.* Rather rare. Sept.-Oct. Barnacle Lane, Combe, *Adams.* Hampton-in-Arden ; Westwood Coppice, Sutton Park.
216. **Ag. versipellis**, *Fr.* Grassy spots in woods. Oct.-Nov. Combe Ridings, *Adams.* Sutton Park; Trickley Coppice.
217. **Ag. mesophæus**, *Fr.* Rare. Oct. Ansty, *Adams.* School Rough, Marston Green.
218. **Ag. sinapizans**, *Fr.* Damp woods. Sept. Alveston Pastures Wood, Sept., 1881.
219. **Ag. crustuliniformis**, *Bull.* Woods. Oct. Kenilworth, *Russell, List.* Ansty, *Adams.* Near Packington, in rings amongst grass.
220. **Ag. elatus**, *Batsch.* Rare. Sept. Knowle, *Hawkes !*
221. **Ag. longicaudus**, *Pers.* Woods. Rare. Oct. Brown's Wood, Solihull.

Sub-genus XXII.—Flammula.

222. **Ag. lentus.** *Pers.* On stumps. Oct. Foot of post, Dunn's Pits Lane, Kenilworth, *Russell, Illustr.* Combe, *Adams.* The Lyes, Kenilworth.

223. **Ag. gummosus,** *Lasch.* On stumps. Rare. Oct. Driffold Lane, Sutton.

224. **Ag. carbonarius,** *Fr.* Rare. On burnt earth, Sutton Park, Oct., 1884, *Dr. Cooke!* Combe Ridings, *Adams.*

225. **Ag. flavidus,** *Schæff.* On trunks of trees. Oct. Packington Park, *With.*, 205. Meadows, near Kenilworth, 1871; Kenilworth, 1876, *Russell, Illustr.* Ansty, *Adams.* Old Park Wood, near Alcester; Windley Pool, Sutton.

226. **Ag. conissans,** *Fr.* Oct. Rare. On willow trunks, Sutton Park, *Dr. Cooke, Illustr.*, pl. 445. Packington Park.

227. **Ag. inopus,** *Fr.* *Ag. connatus,* With. Lord Aylesford's Park, Packington! *With.*, 207. Coleshill Pool; Bradnock's Hayes; Trickley Coppice; Sutton Park.

Sub-genus XXIII.—Naucoria.

228. **Ag. cucumis,** *Pers.* Grassy places. Rare. On a lawn in a garden at Kenilworth, Oct., 1870. *Russell, Illustr.* Sutton Coldfield, Sept., 1883; Nov., 1888. "I agree entirely with those who consider this merely = *A. pisci-odorus.*"—W. B. G.

229. **Ag. melinoides,** *Fr.* *Ag. lacrimalis,* With. Oct.-Dec. Edgbaston; Packington Park, *With.*, 244. Fields, Ansty, *Adams.* Field near Mr. Knowle's house and Dale House Lane, Kenilworth, *Russell, Illustr.* New Park; Sutton, etc.

230. **Ag. striæpes,** *Cooke.* Amongst grass, Ansty, Sept., *Adams!*

231. **Ag. sideroides,** *Bull.* Rare. Dunn's Pits Lane, Kenilworth, Oct., 1868, *Russell, Illustr.*

232. **Ag. pediades,** *Fr.* Pastures. Rare. Aug. Field opposite Orice Hill, Birmingham Road, Kenilworth, *Russell, Illustr.* Ansty, *Adams.* Bradnock's Marsh.

233. **Ag. semiorbicularis,** *Bull.* Pastures. Frequent. Aug.-Oct. The Cliff; The Spring, Kenilworth, *Russell, Illustr.* Mill Fields, Ansty, *Adams.* Sutton Park; Maxtoke Park; Kingsbury Wood; Fillongley, etc.

234. **Ag. sobrius,** *Fr.* Meadows. Oct.-Nov. Meadows, The Spring, Kenilworth, *Russell, Illustr.*

235. **Ag. erinaceus,** *Fr.* *Ag. lanatus,* Purt. March. At Pophills, on the dead branch of an oak, *Rev. W. S. Rufford,* in *Purt.*, iii., 211.

236. **Ag. conspersus**, *Pers.* Woods. Rare. Aug.-Sept. Crackley Wood, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.*

237. **Ag. escharoides**, *Fr.* On the ground. Sept. Malthouse Lane, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow, *Adams.* Heathy waysides, near Coleshill Pool.

Sub-genus XXV.—GALERA.

238. **Ag. lateritius**, *Fr.* *Ag. colus*, With. Pasture field, Edgbaston, Aug., 1792, *With.*, 276. Coughton, and pastures about Gorcot Hall, *Purt.*, ii., 650. On comparison of Sowerby's "upper figure," pointedly referred to by Withering, with the figures of *Ag. lateritius*, and noticing the "loose gills," its extreme fragility, and other distinctions which he draws, it is rendered probable, at least, that his *Ag. colus* is this species; whether the same may be said of Purton's, is not so sure. Withering was well acquainted with *Ag. tener*, which he describes exactly, p. 245; moreover, *Ag. lateritius* has the true "distaff" *(colus)* shape, which *Ag. tener* has not.

239. **Ag. tener**, *Schæff.* Plantations, gardens, amongst grass, etc. June-Oct. Edgbaston, amongst grass, *With.*, 245. Between the rows of asparagus beds (Alcester ?); in a field at Oversley and Kinwarton, among grass, *Purt.*, iii., 221. Ansty, *Adams.* School Close, *Rugby Sch. Rep.* Sutton and Sutton Park; Edgbaston Park; Trickley Coppice; Olton; pine wood, near Coleshill Heath; Parley Park, near Atherstone; Marston Green, etc.

240. **Ag. ovalis**, *Fr.* Manure heaps. Aug. Manure heaps, Dunn's Pits Lane, Kenilworth, *Russell, Illustr.*

241. **Ag. antipus**, *Lasch.* On soil. Rare. On the bare soil of garden, Clarendon Villa, Kenilworth, *Russell, Illustr.*

242. **Ag. sparteus**, *Fr.* Amongst moss. Sept. Crackley Wood! Kenilworth, *Russell, Illustr.*

243. **Ag. rubiginosus**, *Pers.* Among moss. Barnacle Lane, Combe, *Adams.*

244. **Ag. hypnorum**, *Batsch.* On mossy banks. Not rare. Sep.-Oct. Kenilworth! *Russell, List.* Sutton Park; Trickley Coppice; Cut Throat Wood, Solihull; Crackley Wood, Kenilworth; New Park, Middleton; Langley, etc.

Var. *sphagnorum*, Pers. Sutton Park! Oct., 1883, *Dr. Cooke.* Cut Throat Wood, Solihull; Haywood; Hampton-in-Arden.

245. **Ag. mycenopsis**, *Fr.* Marshy ground. Oct. Olton Reservoir, Oct., 1881.

Sub-genus XXVI.—TUBARIA.

246. **Ag. furfuraceus,** *Pers.* *Ag. circumseptus,* With. On chips in hedges, etc. Aug.-Oct. Edgbaston, in pasture lands, *With.*, 244. Crackley Wood, and garden near Kenilworth, *Russell, Illustr.* Fields, Ansty, *Adams.* Sutton; Trickley Coppice; New Park, Middleton; Olton; Marston Green; Coleshill Heath; Shustoke.

(To be continued.)

DESCRIPTIONS OF TWO NEW VARIETIES OF BRITISH SHELLS—*HELIX HISPIDA* VAR. *ELEVATA* AND *LIMNÆA PEREGRA* VAR. *CONVOLUTA.*

BY JOSEPH W. WILLIAMS.

The following two new varieties of shells which have come into my hands have, I believe, not been described as yet in either our home or Continental literature. They are both well-marked and interesting examples of the amount of change in structural conformation of shell to which some of our mollusca are liable.

Helix hispida var. *elevata.*—Width, 5 mill.; height, 4·5 mill. Shell small, brown, hispid. Spire flat, compressed, raised like a dais above the body-whorl; suture between the body-whorl and the adjacent whorl very deep, canaliculate; umbilicus very small; aperture sublunate. Looking at the shell from the aperture, it has, in some degree, the appearance of the shell of *Valvata piscinalis* (Müll), with the apical whorls of the spire depressed. Sent to the describer for the purpose of naming by Mr. A. E. Baker, of Leicester.

Locality.—Evington.

Limnæa peregra var. *convoluta.*—Length, 12 mill.; width, 12·5 mill.; length of aperture, 15 mill.; width, 11 mill. Shell small, ampullaceous, horn-colour, sculpture somewhat prominently plicate. Aperture suboval, patulous, convolute, quite concealing the spire; labrum inflected so as to become sulcate. Well marked on the outside of the shell with growth-varices. Collected by the author.

Locality.—Hillage Pool, Stourport, Worcestershire.

This variety somewhat reminds one in general form of what Hartmann, in 1842, described as *Gulnaria ampla*, now known as a variety of *Limnæa auricularia* (Linn.). It is, however, decidedly a form of *Limnæa peregra*, not taking into account the fact that *L. auricularia* does not occur in, or anywhere near, Hillage Pool.

35, Mitton, Stourport.

BOTANICAL NOTES FROM SOUTH BEDS,

WITH VOUCHER SPECIMENS.

NAME.	DATE 1888.	DATE 1888.	ASPECT 1888.	SITUATION, &c. 1888.
Mercurialis perennis ..	Feb. 12	Dec. 9	S.W.	Hedge bank. Three female stems, with buds and foliage.
Ditto ditto ..		,, 26		Coppice. Male flowers plentiful, female rare.
		1889.	1889.	1889.
Poten. Fragariastrum ..	Apr. 15	Jan. 20	N.W.	Bank. Numerous flowers and ripe fruits.
Corylus Avellana ..	Jan. 29	,, 26	N.	Hill top. Female only
Tussilago Farfara ..	Mar. 3	,, 26	S.	One flower only
Cardamine hirsuta ..	,, 30	Mar. 9	S.W.	Brook side.
Petasites vulgaris ..	,, 4	,, 9	Open	Moist meadow. In 1888 only one plant in blossom, March 4th, which was cut off by frost. The plants generally were a fortnight earlier in 1889 than in 1888.
Helleborus viridis ..	Apr. 1	,, 10	W.	Moist meadow.
Ran. Ficaria	Mar. 30	,, 10	S.E.	Country orchard.
Anemone Pulsatilla ..		Apr. 1		Barton Hills. On Chalk; Mr. C. Crouch.
Caltha palustris.. ..	Apr. 13	,, 1	N.	Barton Spring. Mr. C. Crouch.
Anemone nemorosa ..	,, 15	,, 13	Open	Moist meadow.
Viola Reichenbachiana		,, 19	W.	Coppice.
Nepeta Glechoma ..	,, 28	,, 20	N.	Plantation.
Stellaria Holostea ..	May 12	,, 21	,,	Hedge. One blossom.
Primula veris	Apr. 21	,, 21	W.	Meadow.
Prunus spinosa	,, 29	,, 27	Open	Hedge.
Cardamine pratensis ..	May 12	,, 27	,,	Meadow.
Scilla nutans	,, 13	,, 27	S.	Coppice.
Galeobdolon luteum ..		May 4	W.	Hedgebank.
Sisym. Alliaria	,, 12	,, 4	,,	Bank.
Ger. Robertianum ..	,, 21	,, 18	,,	Bank. Plentiful.
Orchis Morio		,, 19	Open	Pasture.
Cratægus monogyna ..	,, 13	,, 23	N.	Hedge.

The unusually warm weather of the late autumn of 1888 brought on the plants of *Mercurialis perennis*, so that many of them had thrown up their vernal shoots early in December, and were in full blossom before the end of the year. With reference to *Tussilago Farfara*, observations have been continued in the same station since 1880, the date for each year being as follows:—1880, March 3rd; 1881, January 29th;

1882, January 25th; 1883, January 22nd; 1884, January 12th; 1885, February 8th; 1886, March 3rd; 1887, February 5th; 1888, March 3rd; 1889, January 26th.

Jas. Saunders, Luton.

Wayside Note.

Balea perversa in Nottinghamshire.—After seeing Mr. J. W. Williams, in London, and on my return to Nottingham, I referred to Mr. Mussón's list and found that it contained several localities for *Balea perversa*, which are as follows:—"Recorded from Colwick, Highfield House (rare); Annesley (rare, old church wall). Plentiful under stones of church wall at Staunton. S.E. Notts. Plentiful under bark and in cracks of willow trees at Darleton, Notts, April 23rd, 1886."—Geo. W. Mellors, Second Avenue, Sherwood Rise, Nottingham.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section, July 16th. Mr. Chas. Pumphrey in the chair. Exhibition of specimens by Mr. Herbert Stone:—*Galeopsis versicolor*, *Drosera rotundifolia*, in flower; *Vaccinium oxycoccos*, in fruit; *Stratiotes aloides*, from Aspley, near Warrington; also, *Pholas crispatus* and *Tubularia indivisa*, from Hilbre Island, near Liverpool.—Sociological Section, July 23rd. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Martineau exhibited *Merisus intermedius*, a hymenopterous insect, parasitic upon the Hessian fly (*Cecidomyia destructor*). Mr. Hughes exhibited *Lythrum salicaria*, *Malva moschata*, *Geranium pratense*, *Campanula Trachelium*, *Cercis siliquastrum*, the Judas tree, *Melilotus officinalis*, *Reseda luteola*, and other plants from Evesham; also, *Verbascum nigrum*, from St. Albans.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—May 20th. Mr. J. W. Neville exhibited flowers of the Toothwort, *Lathræa squamaria;* Mr. H. Hawkes, *Puccinia sessilis* and *Stemonitis fusca;* Mr. Camm, *Physarum cinereum*, from a timber yard; Mr. J. Moore, gizzard of *Phyllobius argentatus;* Mr. Deakin, fish scales and teeth in carboniferous shale; Mr. Parker, quartz geode containing lead crystals.—May 27th. Mr. Camm exhibited the following fungi under the microscope:—*Lamproderma irideum*, *Tilmadoche mutabilis*, *Pachnocybe subulata*, and *Stemonitis fusca*, the latter from the plasmodium stage to the mature form. Mr. T. H. Waller, B.A., B.Sc., then gave a lecture on "Rowley Rag," in which he said that this being a local rock would give everyone an opportunity of studying it to the fullest extent. It formed a sheet of considerable extent, reaching from Rowley Regis to Dudley, and through it several shafts were sunk to get at the coal beds below. In Earl Dudley's pit 170 yards of basalt had to be bored through. There were two kinds of basalt, Roche and Bluestone; light veins were found in some specimens; these contained ten per cent. more silica. The texture of the rock varied immensely, one interesting feature being the sudden change of texture. The uncertainty of its cleavage appeared to depend on the normal jointing of the rock in the quarry. Its microscopic structure was described,

and the appearance of the crystals of felspar, augite, apatite, and olivine, and their order of crystallisation, and the transition of olivine in some rocks into serpentine. The solidification of a rock was a progressive process, and, though we begin with Rowley Rag, we find it so typical that we can get to almost any rock on the globe. The lecture was illustrated by a series of rock sections under the microscopes.—June 3rd. Mr. J. W. Neville exhibited slabs of Wenlock Limestone containing trilobites, &c.; Mr. J. Corbet, a series of the larger corals from the same formation; Mr. J. Moore, nine species of Zonites, and, under the microscope, palates of the same; Mr. H. Hawkes, a marine alga, *Ptilota plumosa*, in fruit.—June 17th. Mr. J. Madison showed specimens of *Limnæa truncatula*, *L. peregra*, *Neritina concava* and *Cochlicopa lubrica*, from the Eocene beds of Headon Hill; Mr. C. P. Neville, a specimen of spider crab; Mr. Corbet, lignite from the "fossil forest," Brook Point, Isle of Wight, and nodules of marcasite from the chalk; Mr. H. Hawkes, *Tilmadoche mutabilis;* Mr. Camm, *Sphæria ovina* and *S. hispida*.—June 24th. Mr. J. Moore gave a report of the Excursion to Salford Priors, and showed many varieties of *Helix nemoralis*, collected on the way; Mr. H. Hawkes showed a collection of plants and fungi from the same locality, among the latter was the Œcidium stage of *Puccinia phragmitis*. Mr. W. J. Parker then read a paper on "The Eyes." The writer said the eyes were most interesting, from the fact that they were the inlet of nearly all knowledge, and described the situation of the eyes, the structure of the crystalline lens, ciliary processes, choroid coat, retina and optic nerve, and showed that the eyes of the vertebrata differed but little from each other, except in minor ways. After comparing them with the eyes of insects and crustaceans, the writer referred to certain defects in vision, the most remarkable of which was "Daltonism," or colour blindness. The paper was illustrated by diagrams and microscopic slides.—July 1st. Mr. Linton exhibited a collection of fossils from the Portland beds; Mr. J. Collins *Spirogyra porticalis*, showing mature zygospores; Mr. A. Camm, *Trichia fallax* var. *minor*, a fungus on holly leaf.—July 8th. Mr. J. Madison exhibited a case of shells, showing varieties of *Unio*, *Anodon*, &c.; Mr. P. T. Deakin, two cases of shells, one of the smaller Helices, and the other of the Planorbis genus; Mr. J. Betteridge, specimens of Reed Warbler and Sedge Warbler, and three nests of the latter, showing a great variation in form; eggs of both birds were also shown; Mr. J. W. Neville, a number of specimens of Clausilia, from various foreign localities.—July 15th. Mr. J. Collins exhibited under the microscope, *Prasiola crispa*; Mr. J. Moore, gizzard of bee and wasp; Mr. Corbet, a collection of polished pebbles, agates and fossil corals, from Devonshire; Mr. J. Linton, a number of fossils from the Oxford clay, Peterborough. Mr. B. Cracroft then read a paper, "Notes on an Excursion to Cheddar," describing the journey from Weston-super-Mare, through several picturesque villages. The first appearance of the Cheddar rocks reflected in the sheet of water, collected from nine springs, was very imposing. At every step the scenery changes; the castellated form of some of the rocks being very striking. But the charm of the district was the caverns, where water oozed through every part, forming stalactites and stalagmites of singular form and beauty; and when we are told that thirty years had not added appreciably to them, some idea may be formed of the countless ages to which they owe their origin. The geological features of the rocks were referred to, and the rarer plants adorning them enumerated. The paper was illustrated by a series of photographs.

THE FIN WHALE FISHERY IN NORTH LAPLAND.*

BY H. BALFOUR, M.A., F.Z.S.

At the beginning of August last summer, in company with Mr. A. H. Cocks, I made a trip to the extreme North of Scandinavia. Our object, to a great extent, was to visit some of the whaling stations situated in North Finmarken or Norwegian Lapland. My friend had already visited these stations on several occasions, and has published a very interesting series of papers in the "Zoologist" (see list given at the end). Our journey across from Hull to Throndhjem did not produce any thing of special interest, though five whales were passed when about fifteen hours from the English coast. In the Throndhjem Museum one has the opportunity of studying many of the local Cetacea, of which several very well preserved specimens may be seen.

We left Throndhjem in one of the coasting mail steamers, which carried us as far as our destination, the little town of Vardö in East Finmarken; and, as the vessel had some seventy or more stations to call at on the way, in and out of the fjords and islands, we had ample opportunity for feasting our eyes upon the magnificent and varied coast scenery. The journey occupied a week. We saw several of the smaller Cetacea *en route*, chiefly dolphins of different species, and it was very interesting trying to identify these, though by no means easy, from the rapidity of their movements, and from the fact of more than one species associating together in "schools." One smaller species we identified frequently, *Delphinus Albirostris*, the "Springer" of the Norwegians. This species is characterised by its bold colouring of black and white in patches, its pure white beak, and very marked caudal keel. It springs very high out of the water when fishing, or sometimes apparently for the pure enjoyment of the thing; or possibly in the endeavour to shake off trouble-some parasites.

Besides these, *D. tursio* appeared to be common, and on my return south, I met with the Pilot or Ca'aing Whale (*Globiocephalus melas*), in small "schools." Porpoises were fairly abundant in twos and threes, easily distinguished by the low and obtuse dorsal fin; occasionally might be seen a

* Read before the Oxfordshire Natural History Society, April 2nd, 1889.

"Killer" (*Orca gladiator*), with its extremely high, scythe-like dorsal fin and gleaming white belly. These could be seen feeding in company with "schools" of dolphins, and perhaps a Lesser Rorqual (*Balaenoptera rostrata*), following the shoals of herrings, the whole presenting a very busy scene. Flying over the water would be hundreds of gulls, and sometimes a pair of ospreys would "join the glad throng."

It was late in the season, and fewer Cetacea were to be seen than would have been the case a little earlier. During our journey east of the North Cape we saw no whales. The coast here is a "howling wilderness," a very "βδέλυγμα τῆς ἐρημώσεως," and the chief objects of interest, beyond the solemnly impressive coast line, were the various "Fugelbergs" or bird-cliffs, covered with close-packed thousands of gulls, kittiwakes chiefly, which present a marvellous sight. We reached the odoriferous little town of Vardö at the week's end, and found it looking extremely uninviting. Cod fishery is its principal industry, and it advertises this fact to an almost intolerable extent. The streets are paved with codfish heads and tails, with stacks of dried codfish everywhere, and acres of codfish hung on poles, drying to become "Stockfish," and emitting an effluvium better left undescribed. We went almost immediately down to the nearest whale "factory," to see if anything was going on. One's first instinctive impulse on reaching a whale factory, especially if there is a whale in process of demolition, is to turn round and retire again as fast as possible. There is an odour connected with these establishments which defies description. As soon, however, as one can subdue this prompting to flee, one rapidly becomes interested in the scene, and puts up with the horribly aromatic surroundings. On this occasion a common Rorqual was the centre of interest. To get close to a whale stranded at one of these factories, it is always necessary to manœuvre considerably, as the beach for hundreds of yards round a factory is covered along the high water mark with whale remains in various states of decomposition; bones, blubber, entrails, &c., about a foot or eighteen inches deep, the barrier being much too wide to jump, and not inviting any attempts in that direction, as a false step would be disastrous in the extreme. One must select a path across, and choose portions which seem more consistent than the rest, and so step over, the whole slippery mass quaking violently as you cross, and perhaps letting you in over your ankles in cetacean decomposition. Once across it is not so bad, though still you have to be careful not to slip on the smooth rocks, as you may thus be at any moment deposited in a pool not of salt water, but of

blood, which flows in great streams from the whale's body. These are the more unpleasant details, and I will not enlarge upon them further.

The town of Vardö is situated on a small island, and boasts of two whaling "factories," while others are built upon the mainland opposite. It is often difficult to cross over to the mainland, as the sound is frequently rough, and impassable to such cranky little tubs as one can borrow; though the waves *break* very little during the whaling season, because of the film of oil, escaped from the factories, which overlies the whole.

Besides the stations at Vardö we visited one at Yeretiki, on the Murman coast, to the north of the Kola Peninsula; but here, unfortunately, owing to the lateness of our arrival, no whales were brought in during our brief stay of two and a half days.

It may be well, before describing the methods of capture, &c., to give a brief account of the different species of "Fin Whales" which are the objects of pursuit in these regions.

The "Whalebone Whales" are divided into two groups: I. The *Balænidæ* or "Right Whales," including two northern species, the "Greenland Whale," and the "Atlantic" or "Biscayan Whale." These have no dorsal fin, the skin of the belly is smooth, the rostrum of the skull is compressed and rounded, and the rami of the lower jaw are strongly arched outwards, the baleen is very long, the flippers are short. The Greenland Whale averages 50ft. to 60ft. in length, the Biscayan somewhat less. II. The *Balænopteridæ*, including the "Humpbacked Whale," and the Rorquals or "Fin Whales." It is with these that I have to deal, as the whales regularly hunted off these coasts all belong to this group.

The group is divided into two genera:

A.—*Megaptera*, containing the species *M. boöps* frequenting these coasts. Norwegian, "Knöl."

B.—*Balænoptera*, including the following local species:

1.—*B. musculus*, the Common Rorqual or "Razorback," the "Fin hval" of the Norwegian whalers.

2.—*B. Sibbaldii*, Sibbald's Rorqual or "Blue Whale." Norwegian, "Blaa hval."

3.—*B. borealis*, Rudolphi's Rorqual. Norwegian, "Sej hval."

4.—*B. rostrata*, Lesser Rorqual. Norwegian, "Vaage hval."

Briefly, the characteristics of these species are as follows: *Megaptera boöps*, the "Humpback." Average length 45ft. to 50ft. Head large in proportion to body; tail broad; the flippers enormously long (often about 15ft.), narrow, serrated along the anterior margin, with large knobs along the edges; colour jet black above, and white mostly below, flippers usually for the most part gleaming white; baleen short and entirely black, the bristles forming the fringe short and coarse, and of a dirty brownish white; body stout and comparatively short; the pleats on the belly broad.

Balænoptera musculus, Common Rorqual. Average length 60ft. to 70ft, but often considerably more. Long and comparatively slender body; flippers very short; colour deep greyish slate above, white below, flippers rather lighter than the upper part; the pleats on the under surface narrower and more numerous than in the Humpback; baleen black on the outer edge, becoming slate colour towards the middle, and striped with yellow on the inside; bristles coarse, and light coloured, the plates short. (The name Rorqual is derived from the Norwegian "Rorq hval" = a whale with pleats or folds in the skin).

B. Sibbaldii, "Blue Whale," averages 60ft. to 80ft. in length, being the largest of the whale family. Head broad; flippers large; dorsal fin extremely low; robust build; colour deep bluish slate above, slightly paler below, no white except on underside of flippers; baleen jet glossy black, including the bristles; plates broad.

B. borealis, Rudolphi's Rorqual. Average length 35ft. to 45ft. Head broad; dorsal fin small, but comparatively higher than in *B. musculus*; flippers long and broad, pointed at the ends; colour black above, light colour below, flippers usually black on the outer and white on the inner surfaces; baleen black, with white bristles, these being of much finer texture than in the other species.

B. rostrata. As the Lesser Rorqual is not regularly hunted off these coasts, no particulars need be here given of this small species.

In habits these species differ slightly, though they seem for the most part to be governed by the same general instincts, and their movements and modes of living are to a very great extent the same. The range of the different species varies considerably. A difference is seen in their action in the water. In "sounding," that is diving straight downwards, the Humpback almost invariably disappears vertically, tossing the flukes of the tail high in the air; the Blue Whale

sometimes does, the other species rarely or never.* The Humpback, moreover, is the only northern species possessing a well-marked voice. This whale "screams" loudly when lanced. It is said that the Sperm Whale of the south also "gives tongue" when struck, and I have seen the same thing attributed to some species of dolphin. The other Rorquals are all silent, however much they may protest with their enormously powerful tails.

By September most of the whales have left these coasts, and the season is coming to a close. The Blue Whales are usually the first to go, but the others follow quickly, and the season ends somewhat abruptly.

The breeding habits of these whales are still but imperfectly known. It seems likely that pairing does not occur at any fixed period, while the period of gestation is probably a long one, usually more than a year. The newly born young is, roughly speaking, one-fourth the length of the mother. Thus a new-born Common Rorqual would be from 15ft. to 18ft. long, while the Blue Whale seems to give birth to proportionally larger offspring, 23ft. being no unusual size (a somewhat formidable progeny, one must admit !). The young of this species usually accompany the mother for a considerable time; they are frequently seen in company when the young is 50ft. long, and presumably "of age."

The chief food of the Fin Whales consists of herring, small cod, and capelan ("Lodde," Norwegian; *Mallotus arcticus*); also of large quantities of "Kril," *i.e.*, minute Crustacea (*Euphansia inermis*); and *Calanus Finmarchicus*. The *Euphansia inermis* are small thysanspod crustacea, about 1½in. long, and semi-transparent, frequently found in masses inside the jaws of a stranded whale, sticking to the fringe of the baleen. *Calanus Finmarchicus* is one of the Copepoda, of a bright reddish colour, also found in masses on the baleen. This is apparently the chief food of Rudolphi's Rorqual, which takes it in vast swarms near the surface.

Probably, besides those I have mentioned, many other animals provide food for these whales, such as Nudibranch Mollusca, Medusæ, and Pteropods, but traces of these are not easily found, as they are so rapidly digested.

There are various common forms of parasites, which infest the Balænopteridæ of Finmarken. Two of the commonest appear to be restricted to one only of the local species of Fin Whale, viz. the Humpback. These two parasites

* The Greenland Right Whale tosses its flukes in the air as a general custom, in the same manner as the Humpback.

are *Coronula diadema* and *Conchoderma auritum*, both belonging to the group Cirripedia, and allied to the barnacles. The Coronula occurs often in large masses on the Humpback, especially round the snout and on the flippers, the individuals being sometimes sunk deep into the dermis, and sometimes projecting like large warts.

The Right Whale of Greenland carries none of these Cirripedes, while its near ally the Biscayan Whale is usually infested with them; and the western whalers used to distinguish between whales without "calcareous plates" so called, these being the Greenland Whales, and those with "calcareous plates," the Biscayan Whales, or "Nord Kaper" as called by the Dutch and German whalers ("*Sarde*" *of the Basques*). The Humpback becomes early infested with these parasites; in fact, some whalers have affirmed that they are *born* with them, but such a case of "transmission of acquired character" is obviously highly improbable.

The *Conchoderma*, which somewhat resembles the common ship's barnacle (*Lepas anatifera*), is usually found attached to the shells of the Coronulæ, parasitic upon a parasite; or perhaps "symbiotic" more properly expresses this form of association. Almost every Humpback captured is infested with these two animals, sometimes to a marvellous extent.

The third common parasite is a Cyamus, or "Whale Louse;" this enjoys a free moving existence on the whales, either upon the surface, or burrowing a short distance below. A small Copepod is commonly found upon the baleen plates of the Blue Whale, and appears to be restricted to this species, unless we except Rudolphi's Rorqual perhaps. It was described by Herr Aurivilius, of Upsala, and named *Balænophilus unisetus* (*nov. gen. et sp.*).*

Various Entozoa occur, Echinorhynchi being most commonly met with, especially in Rudolphi's Rorqual.

I have given but a brief sketch of the natural history of these whales, as I wish now to turn to the question of their capture and conversion into merchandise.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 186.)

LEES, IN "BOTANY OF THE MALVERN HILLS."

* **Typha angustifolia**, 48. Abundant at New Pool, Malvern Chace. Ill.

* V., P. Z. S., 1886.

* **Sparganium natans**, 48. (*S. minimum in 3rd Edition.*) From a muddy pool at Cotheridge. From the late John Walcot, Esq. *A true record for Sparganium minimum.* Ill. *See ante, "Midland Naturalist," Vol. XI., p. 206.*

Lemna minor, 43.

* **Potamogeton natans**, 45. Ill.

† **P. lanceolatus**, 45. An error. Omitted in the 2nd and 3rd Editions.

P. perfoliatus, 45.

P. crispus, 45.

P. gramineus, 45. *P. obtusifolius (P. gramineus Sm.) is probably intended here.*

P. pusillus, recorded from Kempsey Ford in the Ill. is omitted in the 1st and 2nd Editions, but noted in the 3rd as growing in a pool on Barnard's Green.

* **P. pectinatus**, 45. Ill.

* **Zannichellia palustris**, 47. Pools on Welland Common.

* **Triglochin palustre**, 46. Ill.

* **Alisma Plantago**, 46. Ill.

* **Butomus umbellatus**, 47. Castle Morton, bordering on Longdon Marsh. Ill.

* **Hydrocharis Morsus-ranæ**, 48. Pools. E. Ill.

* **Orchis pyramidalis**, 47. Ill.

* **O. ustulata**, 47.

O. morio, 47.

O. mascula, 47.

* **O. latifolia**, 47.

* **O. maculata**, 47.

* **Gymnadenia conopsea**, 47. Ill.

* **Habenaria viridis**, 47. Ill.

* **H. chlorantha**, 47. Woods on the Limestone. *Ill. as O. bifolia.*

H. bifolia, 47. Open pastures. E. and W. Ill.

* **Ophrys apifera**, 47. About the vicinity of the Croft and Leigh Sinton Lime Works. Ill.

* **Neottia spiralis**, 47. (*Spiranthes autumnalis.*) Ill.

* **Listera ovata**, 47.

* **L.** (*Neottia*) **Nidus-avis**, 47. Ill.

* **Epipactis latifolia**, 47. In most of the western woods.

* **Iris fœtidissima**, 43. Ill.

I. Pseudacorus, 43.

* **Narcissus Pseudo-narcissus**, 46. In New's Wood, and several others about Little Malvern. Ill.

* **N. biflorus**, 46. In orchards at the Berrow. Ill.

‡ * **Galanthus nivalis**, 46. In a little meadow at the northern base of the Herefordshire Beacon. Ill. *In the County of Hereford.*

* Tamus communis, 48.

* Paris quadrifolia, 46. In most of the shady woods on both sides of the hills. Ill.

* Tulipa sylvestris, 46. In an abandoned limestone quarry at Mathon. Ill.

* Allium vineale, 46. Borders of the fields about Malvern Wells and Hanley. Ill.

* A. oleraceum, 46. Rare. E. Ill.

* A. ursinum, 46. Moist woods. Ill.

* Colchicum autumnale, 46. E. and W. Ill.

* Luzula Fosteri, 46.

L. pilosa, 46.

* L. sylvatica, 46.

* L. campestris, 46.

* L. congesta (*multiflora*), 46. Ill.

* Juncus conglomeratus, 46.

* J. effusus, 46.

J. acutiflorus, 46.

* J. lamprocarpus, 46.

* J. uliginosus (*supinus*), 46. Ill.

J. compressus.

* J. bufonius, 46.

Juncus glaucus is not recorded in the 1st Edition.

Blysmus compressus, 44. Abundant on the margin of springy spots on the hills, especially about the Wells.

* Eleocharis palustris, 44.

E. multicaulis, 44. *In the 2nd and 3rd Editions the locality given is: "Marshy spots on Castle Morton Common." I have never seen this plant in the Malvern district, and think it possible that the next species may have been mistaken for it.*

Scirpus pauciflorus, 44. *In the 2nd and 3rd Editions, same locality as the last. See Scott, "Midland Naturalist," Vol. XI., p. 40.*

* † S. cæspitosus, 44. *Probably an error. Not noticed in the 2nd and 3rd Editions.*

S. fluitans, 43. Pools. E.

* S. setaceus, 43. E.

* S. maritimus, 44. In several ditches about Longdon Marsh.

* S. sylvaticus, 44. Chalybeate Pool. Ill.

‡ Eriophorum pubescens (*latifolium*), 44. On the Colwall side of the hills. *Hereford.*

* E. polystachion (*angustifolium*), 44. Bog on the western base of the Worcestershire Beacon. Ill.

† Elyna (*Kobresia*) caricina. Side of New Pool near Wood Farm. *Not noted in 3rd Edition, nor in "Botany of Worcestershire." Must be an error.*

Carex. *Of this genus thirty-three species are noted. Among them are the following :—*

* **C. dioica**, 48. (*In the 3rd Edition the localities given are : "Bog near Keysend Hill; also in a boggy place on the declivity of the Worcestershire Beacon." "Specimens are preserved in the Herbarium of the Worcestershire Natural History Society, gathered by Mr. George Reece, the assiduous curator."*

† **C. teretiuscula**, 48. *Probably an error.* Not in the 2nd or 3rd Editions. *See Scott, "Midland Naturalist," Vol. XI., p. 40.*

C. ovalis var. bracteata, 48. On the common below Malvern Wells.

† **C. stricta**, 48. Probably an error. *See Scott, "Midland Naturalist," Vol. XI., p. 41.*

C. recurva *(glauca)*, 48.

† **C. limosa**, 48. *Not in 2nd or 3rd Editions. An error. See Scott, "Midland Naturalist," Vol. XI., p. 41.*

* **C. distans**, 48. *Locality in 3rd Edition, Longdon Marsh.*

*(?) **C. paludosa**, 48. *See Miss Beilby, "Midland Naturalist," Vol. XI., p. 307.*

Alopecurus pratensis, 44.

Phleum pratense, 45. *Var. nodosum recorded by Scott.*

Gastridium lendigerum, 45. Sarn Hill, near Longdon.

Agrostis canina, 45.

* **Calamagrostis Epigejos**, 45. Filling a wet field at the Berrow. Ill.

* **Arundo Phragmites**, 45. Abundant in Longdon Marsh. Ill.

Aira cæspitosa, 45.

* **A.** *(Kœleria)* **cristata**, 45. *In 2nd and 3rd Editions. On Raggedstone Hill, Worcestershire.* Ill.

* **Avena flavescens**, 45.

* **Av. pratensis**, 45.

* **Av. fatua**, 45.

* **Triodia decumbens**, 45. Beacon. Malvern Chace.

* **Poa** *(Schlerochloa)* **rigida**, 45. Ill.

* **P.** *(Glyceria)* **aquatica**, 45. Ill.

* **P.** *(Glyceria)* **fluitans**, 45.

P. annua, 45.

· **P. compressa**, 45.

* **P. nemoralis**, 45.

† **Briza minor** ? 45. *An error. In the 2nd and 3rd Editions this is called B. media var. abortiva, with the locality, "Bog at the base of the Worcestershire Beacon." See Scott, "Midland Naturalist," Vol. XI., p. 42.*

B. media, 45.

* **Festuca bromoides** (*sciuroides, Roth.*) 45.

* **F. Myurus**, 45.

* **F. elatior**, 45.

* **F. pratensis**, 45.

* **F. loliacea**, 45.

* **Bromus giganteus**, 45.

* **Br. erectus**, 45.

* **Br. secalinus**, 45.

* **Br. racemosus**, 45. Ill.

* Brachypodium sylvaticum, 45. Ill.
* Brach. pinnatum, 45. Ill.
* Triticum caninum, 45.
* Lolium temulentum, 45.
* Elymus europæus (*Hordeum sylvaticum*, Huds.). In several of the western woods.
* Hordeum pratense, 45.
* Nardus stricta, 45. Ill.
* Pteris aquilina, 50.

Allosorus crispus, 50. In a fissure of a crumbling rock on one of the eastern buttresses of the Herefordshire Beacon, above the Priory Farm, Little Malvern, Worcestershire. Extinct?

* Blechnum boreale, 50. On boggy ground about the hills. Ill.
* Asplenium Ruta-muraria, 50. Ill.
* Asp. Trichomanes, 50. In crevices among the shady rocks of the hills.
* Asp. viride, 50. Ham Bridge. Ill. *See ante, "Midland Naturalist," Vol. XI., p. 223. Extinct.*
* Asp. Adiantum-nigrum, 50. Common on the rocks. Ill.
* Athyrium Filix-fœmina, 51. Ill.
* Ath. irriguum, 52. Bog on western base of Worcestershire Beacon. Var. of preceding. Ill.
* Grammitis Ceterach, *Ceterach officinarum*, 52. Ill. On a lofty stone wall, close to the road at Great Malvern, near the entrance of Holly Lodge. *Extinct in this locality, see 3rd Edition, which see also for other habitats.*
* Scolopendrium vulgare, 52. Common.
* Aspidium aculeatum, 51. Ill.
* and var. lobatum, 51. Ill.
* Asp. angulare, 51. Ill.

Lastræa Filix-mas, 51.

† L. cristata, 51. In Crow's Nest Wood, between Worcester and Cotheridge, according to the Herbarium of the late Mr. T. Stretch, of Worcester. *An error, not in 2nd nor in 3rd Editions. See Miss Beilby, "Midland Naturalist," Vol. XI., p. 307.*

* L. spinulosa, 51. Ill.
* L. dilatata, 51. Ill.
* L. Oreopteris, 51. Ill.
* Polypodium vulgare, 50. Ill.
* P. Dryopteris, 50. Ill.

† P. calcareum, 50. Ill. *An error.*

(P. Dryopteris and P. calcareum:) *See ante, "Midland Naturalist," Vol. XI., p. 224.*

* Ophioglossum vulgatum, 50. Abundant on the southern side of Longdon Marsh; also in Grimley Meadows near Worcester, Mr. A. Edmunds. 2nd Edition, 1887; on the turf near the entrance of Purlieu Lane, 1850. 3rd Edition; in a field near the new church, Malvern Link.
* Chara flexilis, 49. In great abundance in pools on Castle Morton Common.

C. vulgaris. Pools and bog holes.

C. hispida. Ditches of Longdon Marsh.

N.B.—Cnicus arvensis, 38. *First record is omitted from page 162.*

(*To be continued.*)

THE LAND AND FRESH WATER MOLLUSCA OF NORTH STAFFORDSHIRE.

COMPILED BY JOHN R. B. MASEFIELD, M.A.

Note.—The initials of the authorities quoted refer as follows :—

L. E. A.—Mr. Lionel E. Adams, B.A., Penistone.
J. R. B. M.—Mr. John R. B. Masefield, M.A., Rosehill, Cheadle, Staffordshire.
E. D. B.—Mr. Edwin D. Bostock, The Radfords, Stone.
T. F. B.—Mr. Thos. F. Burrows, Daisy Bank, Cheadle.
F. B. W.—Mr. Fred. B. Webb, Stafford.

AQUATIC.

CONCHIFERA.

SPHERIIDÆ.

SPHÆRIUM.

1.—Sphærium corneum	Common everywhere.
,, v. flavescens	Canals, Stone (J. R. B. M.), Stafford (F. B. W.)
,, v. nucleus	Canal, Barlaston (J. R. B. M.)
2. ,, rivicola	Common, all canals and rivers.
3. ,, ovale	Froghall Canal, very fine (J.R.B.M.) Stoke-on-Trent Canal (F. B. W.)
4. ,, lacustre	Stafford (F. B. W.)
,, v. Brochoniana	Ditto

PISIDIUM.

5.—Pisidium amnicum	Canals, common.
6.— ,, fontinale	On duckweed in ponds, fairly common.
7.— ,, nitidum	River, Stafford (F. B. W.), Colwich (J. R. B. M.)

UNIONIDÆ.

UNIO.

8.—Unio tumidus	In all large pools, meres and canals.
,, ,, v. radiata	Canal, Colwich (J. R. B. M.)
,, ,, v. richensis	Copmere (J. R. B. M.)
9. ,, pictorum	Large pools, meres and canals.
,, ,, v. longirostris	Copmere (J. R. B. M.), Canal, Colwich (F.B.W.), also var. with rich salmon nacre (J. R. B. M.)

ANODONTA.

10.—Anodonta cygnea	Same localities as Unios, very large, in pool, Aston, Stone.
,, ,, v. radiata	Stone Canal (J. R. B. M.)
,, ,, v. incrassata	Hales Hall Pool, Cheadle (J.R.B.M.)
,, ,, v. Zellensis	Copmere (J. R. B. M.)
,, ,, v. pallida	Copmere (J. R. B. M.)
,, ,, v. rostrata	Copmere (J. R. B. M.)
11. ,, anatina	Same localities as last.
,, ,, v. major	Canal, Colwich (J. R. B. M.)
,, ,, v. radiata	Canal, Colwich (J. R. B. M.)

DREISSENIDÆ.
DREISSENA.

12.—Dreissena polymorpha	Walls of Canal, Colwich, very fine, with a variety, with a white line down the centre of each valve (J. R. B. M.), Stafford (F. B. W.)

GASTEROPODA.
NERITIDÆ.
NERITINA.

13.—Neritina fluviatilis	Canal, Colwich (J. R. B. M.)
,, ,, v. cerina	Ditto Milford (L. E. A.)

PALUDINIDÆ.
PALUDINA.

14.—Paludina vivipara	Canals everywhere.

BYTHINIA.

15.—Bythinia tentaculata	Common all canals and rivers.
,, ,, v. producta ,, ,, v. zonata	River Sow, Stafford (L. E. A.)
,, ,, m. decollatum	Stone Canal (J. R. B. M.), Stafford (L. E. A.)
16. ,, Leachii	Ditto, Canal, Haywood (L. E. A.)

VALVATIDÆ.
VALVATA.

17.—Valvata piscinalis	Canal, Stone, Froghall and river Colwich (J. R. B. M.)
,, ,, v. acuminata	Stafford (L. A. A.)
18. ,, cristata	Stafford (F. B. W.)

LIMNÆIDÆ.
PLANORBIS.

19.—Planorbis nitidus	Stafford (E. D. B.), Canal, Oakamoor (T. F. B.)
20. ,, nautileus	Maer Pool (J. R. B. M.), Stafford (L. E. A.)
21. ,, albus	Pools and streams generally.
22. ,, spirorbis	Stafford, Stone (F. B. W.), Froghall (T. F. B.)
23. ,, vortex	Ditto, very common,
24. ,, carinatus	Fairly common, canals, &c.
25. ,, complanatus	Very common.
26. ,, corneus	Local—Canal, Stone (J. R. B. M.), River Sow, Stafford (L. E. A.)
27. ,, contortus	Canal and river, Stafford, Newcastle, Froghall (T. F. B.)

PHYSA.

28.—Physa hypnorum	Stafford (L. E. A.) Burton-on-Trent (Dr. Mason.)
29. ,, fontinalis	On weed in running streams.
,, ,, v. inflata	Cheadle (J. R. B. M.), river, Stafford (E. D. B.)
,, v. curta	Stafford (L. E. A.

LIMNEA.

30.—Limnea peregra	Common in every ditch and pool.
,, ,, v. ovata	Cheadle (J. R. B. M.), river, Stafford (F. B. W.)
,, ,, v. ampulacea	Cheadle, very fine (J. R. B. M.)
,, ,, v. picta	Ditto, one specimen.
,, ,, m. decollatum	Ditto.
31. ,, auricularia	Stafford (F. B. W.), Cheadle and Colwich (J. R. B. M.)
,, ,, v. albida	Colwich Canal one specimen (J. R. B. M.)
32. ,, stagnalis	Barlaston pools and canals, Stone, very fine (J. R. B. M.), Stafford (F. B. W.)
,, ,, v. albida	Pool, Cannock Chase (L. E. A.)
,, ,, v. labiata	Stafford (L. E. A.)
33. ,, palustris	Ditches in meadows generally.
34. ,, truncatula	Ditto.
35. ,, glabra	Canal, Stoke (F. B. W.), ponds near Cheadle—fine (T. F. B.)
,, ,, v. elongata	
,, ,, m. decollatum	

ANCYLUS.

36.—Ancylus fluviatilis	Common on stones in streams.
,, ,, v. capuloides	Stafford—very large (F. B. W.)
,, ,, v. albida	Cannock Chase (J. R. B. M.)
,, ,, v. stricta	Stafford (L. E. A.)
37. ,, lacustris	Common—ponds and pools.
,, ,, v. compressa	
,, ,, v. Moquiniana	Canal, Colwich—local (L. E. A.)
,, ,, v. albida	

TERRESTRIAL.

ARIONIDÆ.

ARION.

38.—Arion ater	Common.
,, ,, v. rufa	Rosehill, Cheadle (J. R. B. M.)
,, ,, v. albolateralis	Stafford, one specimen (L. E. A.)
,, ,, v. brunea	Barlaston (J. R. B. M.)
,, ,, v. nigrescens	Stafford (L. E. A.)
39. ,, hortensis	Common in gardens.
40. ,, Bourginati	Cheadle (F.B.W.), Stafford (L.E.A.)
41. ,, subfuscus	Ditto.
,, ,, v. aurantiaca	Stafford (L. E. A.)

LIMACIDÆ.

AMALIA.

42.—Amalia gagates v. plumbea	Stafford (L. E. A.)
43. ,, marginata	Stone (J. R. B. M.)

LIMAX.

44.—Limax maximus	Common in cellars—one specimen 6½in. in length (J. R. B. M.)
,, ,, v. cinerea	Stafford (L. E. A.)
,, ,, v. Johnstoni	
,, ,, v. fasciata	Cheadle (J. R. B. M.)
45. ,, flavus	Cheadle (J.R.B.M.). Stone (E.D.B.)
,, v. griscea	Stafford (L. E. A.)

46.—Limax cinereo-niger v. maura		Ditto.
,, v. luctuosa		Ditto.
47. ,, agrestris		Very common everywhere.
,, ,, v. nigra		Stafford (L. E. A.)
,, ,, v. lilacina		Stafford (L. E. A.)
,, ,, v. sylvatica		Stafford (L. E. A.)
,, ,, v. albida		Cheadle (J. R. B. M.)
48. ,, lævis		Stafford (L. E. A.)
49. ,, arborum		Cheadle (J. R. B. M.), Stafford (L. E. A.)

HELICIDÆ.
SUCCINEA.

50.—Succinea putris	On flags and reeds by canals.
51. ,, elegans	Stafford (L.E.A.), Stone (E.D.B.)—one specimen.

VITRINA.

52.—Vitrina pellucida	Common under stones everywhere.

ZONITES.

53.—Zonites cellarius	Ditto.
,, ,, v. albinos	Cheadle (J. R. B. M.), Stafford (L. E. A.)
54. ,, alliarius	Under decayed wood and stones.
,, ,, v. viridula	Cauldon (T. F. B.)
55. ,, glaber	Stafford (L. E. A.), Weaver Hills (T. F. B.)
56. ,, nitidulus	Common under leaves, stones, &c.
57. ,, purus	Cheadle (J.R.B.M.), Stone (E.D.B.)
,, ,, v. margaritacea	Cheadle (J. R. B. M.)
58. ,, radiatulus	Cheadle, fairly common (J.R.B.M.)
,, ,, v. viridescenti-alba	High Shut, Cheadle (T. F. B.)
59. ,, excavatus	Byrth Hill, Maer (J. R. B. M.)
60. ,, nitidus	Stafford (L. E. A.)
61. ,, crystallinus	Common, Cheadle (J.R.B.M.), very fine, Cauldon (T. F. B.)
62. ,, fulvus	Cheadle, local (J.R.B.M.), Stafford (F. B. W.)

HELIX.

63.—Helix aculeata	Cheadle, Leek, Grindon (J.R.B.M.)
64. ,, aspersa	Stafford, rare and Colwich, local (L. E. A.)—not further north in county.
65. ,, nemoralis	Common in hedgerows and especially on the limestone (J. R. B. M.)
,, ,, v. libellula	Ditto
,, ,, v. albolabiata	Ditto
,, ,, v. roseolabiata	Ditto
,, ,, v. rubella	Ditto
,, ,, v. castanea	Abundant in Dovedale (J. R. B. M.)
66. ,, hortensis	Fairly common in gardens.
,, ,, v. lutea	Stone.
67. ,, arbustorum	Local, Cheadle (J. R. B. M.)
,, ,, v. alpestris	Grindon (F. B. W.)
,, ,, v. pallida	Ditto and Dovedale (E. D. B.)
,, ,, v. flavescens	Cheadle (T. F. B.)
,, ,, v. cincta	Grindon (T. F. B.)

68.—Helix rufescens	Stafford (L.E.A.), Grindon (F.B.W.)
,, ,, v. rubens	Froghall (T. F. B.)
,, ,, v. albida	Grindon (F. B. W.)
69. ,, concinna	Common under stones, &c.
,, ,, v. albida	Grindon (F. B. W.), Weaver Hills (T. F. B.)
70. ,, hispida	Common at foot of walls, &c.
,, ,, v. albida	Cheadle (J. R. B. M.)
71. ,, caperata	Weaver Hills (J. R. B. M.)
72. ,, virgata	Grindon (F. B. W.)
73. ,, ericetorum	Grindon(F.B.W.)Dovedale(J.R.B.M)
,, ,, v. gricescens.	Near Dovedale (T. F. B.)
74. ,, rotundata	Common under stones and bark.
,, ,, v. albida	Cheadle—one specimen (J. R. B. M.)
75. ,, rupestris	Common on limestone.
76. ,, pygmea	Cheadle (T. F. B.), Stafford (L.E.A.)
77. ,, pulchella	Common on limestone.
,, ,, v. costata	Grindon (F. B. W.)
78. ,, lapicida	Dovedale (J. R. B. M.)
BULIMUS.	
79.—Bulimus obscurus	Cheadle, Stafford, &c.
,, ,, v. albinos	Weaver Hills (J. R. B. M.)
PUPA.	
80.—Pupa secale	Grindon (F. B. W.)
81. ,, umbilicata	Stafford, Cheadle, &c.
82. ,, marginata	Grindon (F. B. W.)
VERTIGO.	
83.—Vertigo pygmea	Grindon (F. B. W.)
84. ,, substriata	Leek (J. R. B. M.)
85. ,, edentula	Cheadle, Leek (J.R.B.M.), Stafford (L. E. A.)
,, ,, v. columella	Cheadle (J. R. B. M.)
BALEA.	
86.—Balea perversa	Cauldon (T. F. B.), Ramsor (J. R. B. M.)
CLAUSILIA.	
87.—Clausilia rugosa	Common on rocks and walls.
,, ,, v. dubia	Stone (E. D. B.)
88. ,, laminata	Stone, Stafford, Cauldon.
,, ,, v. albinos	Grindon (F. B. W.)
COCHLICOPA.	
89.—Cochlicopa lubrica	Common amongst dead leaves (J. R. B. M.)
,, ,, v. lubricoides	Stafford (F. B. W.)
90. ,, tridens	Ilam (T. F. B.)
ACHATINA.	
91.—Achatina acicula	Grindon (F. B. W.), Dovedale (T. F. B.)
CARYCHIUM.	
92.—Carychium minimum	Cheadle (J. R. B. M.), Stafford (L. E. A.)

In Mr. Garner's "History of Staffordshire," he includes the following species, but these have not been met with in recent years :—

"Helix cantiana—not rare in Dovedale and Wetton Valley."
"Helix fusca—Stoke-on-Trent; dell at Oakamoor."
"Helix lamellata—among leaves in a valley at Oakamoor; only three specimens found in October living: Mr. Carter."
"Succinea oblonga—Staffordshire; Birmingham Museum."
"Clausilia biplicata—Alton Castle; Mr. Carter."
"Limnea glutinosa—common, Stoke-on-Trent."
"Planorbis lævis (glaber)—occasional in pools."
"Planorbis lineatus—canals, Stoke."
"Paludina contecta—canals."
"Pisidium obtusale (pusillum)—frequent, Betley Pool."

THE POCKET DREDGE.

BY E. W. BURGESS.

Having many times been much put about when travelling on the seas, and for the purpose of dredging having to make use of zinc-pans, or tinned-meat cans loaded with the log-lead to weight the article used, and the log-line to draw it up to the vessel, I have found much inconvenience in the use of such utensils; and hearing that Mr. David Robertson, of Millport, Scotland, had made a dredge 7in. wide, I thought I would also try to do the same. Therefore I wrote to Mr. W. P. Marshall to get the particulars of the Birmingham Natural History Society's dredges; and he gave me a sketch of the smallest of these to scale, with a few hints about making it. But as I had great trouble in having one made by the blacksmith I applied to, I gave him up and tried another way, by making a model in wood, and getting it cast in brass. I drilled holes in each side to join the head to the bag with copper-wire, and also curved the bars connecting the scrapers, so that the scraping edge should be wider than the inside, and used sacking-canvas for the bag 12in. long, and connected the head to the dredge-rope by two wire handles.

The line attached to the dredge was a strong water-line $\frac{1}{4}$in. in diameter, nearly the thickness of a black-lead pencil, marked in six-feet lengths (fathoms), each five fathoms in similar coloured worsted or a combination of colours twisted through the strands—such as, the first five fathoms red; the next five yellow, &c.—for the convenience of counting the depth of the water dredged.

I found at times a little trouble; the bottom was very rocky, the dredge getting fast and requiring the boat to return over the dredge to free it. In using the dredge, I had a piece of wire-rope nearly the same size as the other, and 4ft. long, attached to the dredge, and at the end furthest from the

dredge a lead weight of 3lb. fastened at the junction of the wire-rope and the marked cord. Also an ordinary wooden cross-frame for winding the cord upon. I used the dredge, as thus made, and found it work very well, except that the bag required altering.

On showing it to a gentleman who has done a great deal of dredging in all parts of the world (Government work, &c.), he advised me to try chains attached to the bars. I tried the chains, and went out dredging. The water was very rough for the small boat I was in, and the dredge would not act, so I altered it back to the wire handles as formerly, and tried a fresh bag made to open at the lower end, and longer, being 24in long. This I found to act splendidly.

Being open at the end, it required tying in a bunch about 2in. from the end ; and on bringing it up full, I untied the end, and dropped its contents out into a coarse sieve of $\frac{1}{8}$in. mesh, lying within a finer one to retain sand and foraminifera, and yet allowing the finer mud to be washed out by agitating the sieve in the sea. The sieve should first be tied to the boat, as I had one knocked out of my hand, and lost it, being metal, in the depths below.

In the coarsest sieve were found brittle-stars, stones, algæ, viz., *Melobesia calcarea* ; and hydroids, as *Sertularius*, *&c.* If possible, a vessel, such as a baling can, might be used in the boat to wash and separate many foraminifera, by putting a portion of the sand or mud in it with water, and giving a rapid circular motion to its contents ; then, on pouring the water through the finest sieve immediately the sand begins to settle, we retain the forms that will float ; always keep some of the mud unwashed, to wash at leisure at home. Then look carefully over the residue for such forms as *Astrortriza limisola*, *&c.* This procedure enables one to carry away less waste material.

Again, the bag can be made of different materials, according to the character of the objects dredged for ; such as an outside bag of open canvas, and an interior bag of silk gauze, which will allow free egress to the water, but retain the objects desired. A small pocket, drawn together by a cord, at the entrance of the bag, made on the principle of an eel or lobster-trap, will retain the objects in case the dredge is inverted.

These few remarks I have made, thinking that some of the members of the Birmingham Natural History and Microscopical Society might like to have such an object as a pocket dredge. As to cost, weight, &c. : Cord, 50ft., 5s. ; making of dredge, under 5s. ; weight of ditto, 3lb. 2oz. ; lead, 3lb. ; total weight, cord, dredge, and lead, 9lb. 2oz.

THE PETROLOGY OF OUR LOCAL PEBBLES.

BY T. H. WALLER, B.A., B.SC.

(Continued from page 178.)

(2) A white quartzite (2) from Sutton.

The component grains are more rounded than is the case in (1), but still they must be called subangular. They are of about the same average dimensions as those in the last specimen, but a quartz vein cuts across the section, and in it the "mosaic" is on a good deal larger scale.

This pebble also contains a considerable quantity of what appears to be a decomposed felspar; the edges of the fragments are only just rounded off, to no greater degree than the quartz grains. One grain was observed showing the cross hatched extinction pattern of microcline.

A good many zircons and tourmalines of considerable size lie among the quartz grains, but not in them; unless one crystal of which the exact form could not be distinguished, but which possessed a high double refraction, may have been a zircon. Some bodies of high refractive index, as shown by the solid appearance they had in the quartz, appeared isotropic, and seemed to have crystal faces, but the shape could not be made out. There is also a number of grains of a colourless, or very faintly yellow, mineral, apparently decomposed, along cracks, which stands out in decidedly greater relief than the quartz grains and does not appear to have the secondary quartz grown to it.

(3) A yellowish white quartzite (4), from Sutton. This pebble contained lingula.

The quartz grains are small, from ·005 to ·003 of an inch. They are slightly rounded, and the cementing quartz is in optical continuity with them. A few flakes of white mica and a few grains of felspar are mixed with the quartz, but the most noticeable feature is the very great richness in zircon and rutile, especially the former. In one field of $\frac{1}{20}$ inch diameter I counted ten rounded grains of zircon and two or three of rutile. They appear to have been loose in the sand from which the quartzite had been compacted.

A small quantity of this quartzite was treated with hydrofluoric acid, and the grains which were left collected by subsidence. They are, as the slide shows, zircons and a few rutiles. In the solution, after evaporation to get rid of the silica, titanic acid and zirconia could be easily detected;

but it did not seem worth while to undertake the very awkward quantitative separation of these oxides, especially as such a large quantity of mineral had escaped solution.

(4) A light quartzite (18), with dark bands about $\frac{1}{30}$ inch wide, and at distances of from three to five-sixteenths of an inch. This pebble was obtained from a stoneheap by the roadside between Alvecurch and Blackwell, so that the exact place in the beds is uncertain.

It is composed of somewhat angular quartz grains, many somewhat rectangular in shape, and in parts of the section these appear to lie with the longer dimension of the rectangle across the direction of the banding, so that, neglecting the banding which, under the microscope, is not very obtrusive, the impression is certainly of the bedding being at right angles or thereabouts to the bands. The dark bands are produced by black cloudy grains of quartz and by a black dust, which in some cases incrusts the quartz grains, and in others is distributed through the cementing quartz. Where it has incrusted the grains it has not by any means always prevented the optical continuity of the old and new material.

Flakes of white mica are rare, and a few zircons are present as usual.

(5) A dark red quartzite (30) from Sutton.

The grains of quartz are subangular, and the rock owes its colour to the pellicle of oxide of iron with which almost every grain is covered. This has prevented the cementing quartz from being deposited on the original, and it fills the interspaces which, from the angular character of the component grains and the consequent close fitting, are, on the whole, small, in masses which show a coloured mosaic in polarised light,

(6) A pebble from Sutton (24) which has the appearance of a coarse grit.

It shows, however, on microscopical examination, that it has been subjected to very great shearing. The larger pebbles are crushed, and in many cases recemented with new quartz; and in scarcely any one of them is the polarisation uniform and normal, but shows the irregular shadows due to the deforming of the crystal. Flowing as it were round them, and prolonged in considerable tails and streams, lie abundant minute flakes of a pale mineral, of high double refraction—probably some form of mica. A few large zircons are present, and there is a very large development of new quartz in the interlocking grains which characterise the schists, but on a small scale.

The rock is exactly the representative of some of the rocks from Sutherland, with which Dr. Lapworth made us familiar some years ago; but the fact of its being made out of a tolerably pure quartz grit produces, of course, a difference in its appearance from the absence of felspar and hornblende, which are present in the crushed gneisses of the north.

(7) A yellow quartzite (9) from Sutton.

This is an example of a rock that has been still further crushed and spread out than the last. The larger pieces forming the "eyes" are in many cases quite broken up, although the pieces are not moved away from each other or only slightly so, and the whole has been cemented into an exceedingly compact mass by abundant quartz, with mica flakes, in just the same way as in the last example.

(8) A dark-reddish, laminated pebble (22) from Alvechurch. Exactly similar stones occur at Sutton.

In this rock the crushing and rolling has gone still further than in the previous case. With the exception of a few opaque spots which seem to have determined the formation of many cracks, which have afterwards been filled or partially so with oxide of iron, I can distinguish no mineral but quartz, much of it in intricately interlocked grains. The whole rock has a good deal of dusty matter distributed through it, usually without any definite arrangement into lines. At most it is slightly heaped together in a few places.

A pebble (38) from Sidnal presents some peculiar features. It has the look of a laminated mass of somewhat opaque grains separated by pale yellow lines, which occasionally show themselves as flakes of golden mica. The crumbly nature of the rock makes a good section difficult to obtain, and what I have got is not in the best direction for examining the specimen. The grains are quartz, but a good deal crushed, and the cementing quartz has the interlocking texture A few fragments of felspar are suggested more than certainly recognisable.

The main points in which the quartzites which I have mentioned differ from those of the Lickey, of the Nuneaton-Hartshill ridge, and of the Wrekin, so far as they are known to me, are

(A) The original quartz grains are very much less perfectly rounded.

(B) The average size is much less.

(C) The quantity of zircons and other heavy minerals is much greater.

I may also refer to Mr. Teall's report on the subject in the paper of Mr. Harrison's previously quoted.

The next group of specimens derived from the pebbles to which I will call your attention is a remarkable set of tourmaline-bearing rocks.

They vary from pebbles consisting of pure white quartz, pierced by needles of tourmaline of the black variety, of quite considerable dimensions, such as No. 6, to others where the mixture of the minerals is more uniform, such as No. 48, from Sidnal Farm, Blackwell, and No. 25 from Sutton, and further to such a perfect schorl schist as No. 5, which I owe to the kindness of Mr. A.T. Evans, who collected it at the King's Heath pit. With these we find specimens at Alvechurch, Moseley, and Sutton, of a sort of breccia, Nos. 7 and 8, in which the component fragments are of a sort of schorl schist, and the cementing material contains also a very large quantity of the tourmaline.

In addition to these we find at King's Heath pebbles of a porphyritic granite and of an elvan in which a large amount of tourmaline is contained. In the latter rock it would appear from the forms of the tourmaline aggregates that they replace, in some instances at all events, crystals of felspar.

To take a few of these in more detail.

(9) Quartz-tourmaline rock from Sidnal's farm, Blackwell.

A coarse-grained mixture of the two minerals. The quartz is clear and polarises in large areas. There are a considerable number of fluid cavities, but none containing salt crystals were observed.

The tourmaline belongs largely to the variety which, in certain directions, possesses the splendid blue colour, in consequence of which the name indicolite has been given to it. As is usual, patches and blotches are differently coloured in the sections, and, except in basal sections, which in several cases are quite hexagonal, there is presented the striking dichroism peculiar to tourmaline. Clustered on the edges of the larger masses are fringes composed of fine blades of the same mineral, with the same blue and yellow colours. These fringes are at times of considerable length, *i.e.*, of about $\frac{1}{100}$ of an inch. It forms an object of great beauty for a low power.

(10) A dark rock (25) from Sutton.

This has the appearance of a dark quartzite, but a thin slice shows that it is really a very similar rock to the last, but of finer grain. It is, also, distinctly schistose, the tourmaline forming more or less connected ramifying strings, made up of very minute grains winding among grains of quartz.

There are, in addition, a number of small blades or needles of tourmaline of more usual appearance. The specimen has been much cracked, faulted, and recemented. The cracks have been filled up with quartz, which is traversed by needles of tourmaline, showing up very beautifully in the transparent quartz.

(11) Tourmaline schist (5) from King's Heath.

Beautifully crystallised schist, with a fine set of micro-faults. The quartz of the veins is larger grained than that of the body of the rock, and contains, as in the last case. needles of tourmaline radiating from the walls of the crack.

(12) Breccia from Alvechurch (8).

Exactly similar pebbles occur at King's Heath and Sutton.

It has the appearance of quartz rock which contained a few fine strings of tourmaline — it scarcely amounts to a tourmaline schist — broken up and cemented by a mass containing a much larger proportion of tourmaline. in many parts containing very little else. In hand specimens and in sections to the naked eye, the brecciated character is obvious, but from the fact of the original tourmaline and that of the cement being of just the same appearance, the whole has, under the microscope, the aspect of a quartz tourmaline rock in which the latter mineral has aggregated into clots and strings.

(13) Appears like a quartz felsite which has been subjected to strong alteration. The specimen (from King's Heath, No. 12) has a sparkling, obviously crystalline ground, in which large quartz grains are visible to the naked eye. There are numerous aggregated masses of crystals of black tourmaline. which in many cases have rectangular outlines indicating the replacement of felspar.

Under the microscope the tourmaline presents the usual characters, but is more widely disseminated through the section than appears macroscopically. The ground shows a mosaic polarisation in quite considerable sized grains, and there are no certain indications of any mineral but quartz composing it.

The larger porphyritic quartz grains are rounded, not very numerous in the section examined, and contain fine acicular crystals of a pale yellowish green, which do not show any definite faces from which to form a judgment as to their nature. There are also numerous fluid cavities, and in one or two of the grains the little crystals are arranged almost concentrically, the section being very nearly at right angles to the principal axis of the quartz. The quartz of the

ground also contains numerous fluid cavities, mostly minute, and some bands traverse the whole which have a dusty appearance, with a low power, but show themselves as due to minute flakes of irregular shape and brownish colour, when a power of about 400 is applied. These bands cut across the grains of the ground, and, indeed, are broader than the average size of them, so that they are probably cracks produced and filled up subsequently to the original metamorphism of the rock. A little apparently rectangular cavity was observed, lined with a number of little orange needles, which, on examination, proved to be quartz crystals stained with iron oxide, and frequently traversed by fine greenish-brown needles apparently of tourmaline.

I have compared with this specimen some sections of "Schorlaceous Elvan" from Cornwall, which Mr. Allport gave me some time ago. The similarity is very great, except that the process of alteration has gone further than in those in which the outline of the felspar portions were still visible (the structure was micro-granitic).

The porphyritic granite, of which mention was made (No. 14) only differs as a hand specimen from the last previously described in the occurrence of large porphyritic crystals of felspar, some being as much as 1in. long. In other respects, such as the grey ground, the porphyritic quartz grains, and the plentiful occurrence of tourmaline aggregates, there is no difference.

SHELLS FROM IRELAND.—Mr. G. W. Mellors, of Nottingham, who has recently visited our sister island, has sent me a small batch of shells which he collected there, and which may be placed on record, as Ireland is a country comparatively unknown to conchologists interested in the chorology of our land and fresh-water forms. From Roundstone, in Co. Galway: *Helix ericetorum* (Müll.) with its vars., *monozona* (Pasc.) and *alba* (Charp.), *Helix virgata* (Da. Costa) with vars. *albicans* (Gratel) and *lutescens* (Moq.), *Helix nemoralis* var. *libellula* (Risso) 00300, var. *carnea* (Roebuck and Taylor) 00300, and var. *Petiveria* (Moq.) 12345; from Westport, in Co. Mayo: *Helix rufescens* (Penn) and var. *alba* (Moq.), *Clausilia rugosa* (Drp.), *Pupa umbilicata* (Drp.), and *Helix rupestris* (Drp.).—J. W. WILLIAMS.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, July 2nd. Mr. W. B. Grove, M.A., in the chair. Mr. J. E. Bagnall, A.L.S., exhibited a number of

plants, collected in the Norfolk Broads by Messrs. R. W. Chase and C. Pumphrey, including *Cicuta vilosa*, *Sium latifolium*, and *Utricularia vulgaris*. The utricles of the last were shown under the microscope.—GENERAL MEETING, July 30th. Mr. W. P. Marshall, M.I.C.E., in the chair. Mr. T. E. Bolton exhibited specimens of *Utricularia intermedia*, from near Bournemouth, Dorsetshire; also, under the microscope, a living spider partly enclosed by one of the utricles of the plant. Mr. W. H. Wilkinson exhibited specimens of plants, from Kent.—GEOLOGICAL SECTION, August 20th. Mr. W. P. Marshall, M.I.C.E., in the chair. Exhibition of specimens by Mrs. Stewart:—*Epilobium angustifolium*, *Senecio squalidus*, from Acocks Green; also, hand specimens of Ben Nevis granite; Miss Taunton, Burdock (Wild Rhubarb), from Buxton; Mr. Herbert Stone, Goby, Sea Louse, and lichens, from Porth Gwarra, Land's End; Mr. Marshall, two nests of Trap-door Spider, from Bordighera in the Riviera.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 22nd. Mr. J. Collins gave a report of the excursion to Arley. The botany was highly successful, though the geology only gave meagre results. He laid upon the table a collection of the more interesting plants, *Saponaria officinalis*, &c. Mr. Deakin exhibited graptolites from the Llandovery Sandstone, Great Barr; Mr. Hawkes, a specimen of butterfly orchis, *Habenaria bifolia;* also, Australian seaweeds; Mr. Camm, *Arcyria dictyonema*, from Smethwick, a fungus new to Britain; Mr. J. W. Neville, lobes of proboscis of *Scatophaga merdaria*, calling attention to the special modifications fitting it for carnivorous habits.—July 29th. Mr. H. Hawkes read a paper on "The Botany of the Sea." The writer said that to those who lived inland a glimpse of the sea was always a source of pleasurable recollection, and gave a description of a visit to the south coast to devote a little time to that much neglected but beautiful order of plants—seaweeds. Although it was a common thing to see albums of marine algæ, yet in too many instances they were without names, and failed to impart other information. The various modes of reproduction were enumerated, and the germ- and sperm-cells, carpogonia and antheridia, which were generally found on different plants, described. Marine algæ were divided into three sections; about 370 species were found on our shores. The various seaweeds commonly found on the south coast were described, with the points of interest attaching to each. Attention was called to differences seen in these plants when growing under varying circumstances, influenced by various depths, light, shade, saltness of the water, &c. The paper also dealt with their economic value, habitats, and areas of distribution. The paper was illustrated by herbarium specimens, microscopic slides, diagrams, and a series mounted for the lantern.—August 12th. Mr. J. W. Neville exhibited specimens of *Monograptus Sedgwickii*, from metalliferous slates of Llandovery age, Central Wales; Mr. Linton, a collection of land shells, from Scarborough; Mr. Corbet, fossil corals from the Carboniferous limestone, Shropshire; Mr. H. Hawkes, algæ, from Weymouth, including some specimens not commonly found there, but brought up by the recent rough weather; Mr. Camm, a fungus new to Britain, provisionally named *Alwisia intermedia* (Mass. and Camm). Under the microscope, Mr. J. Collins exhibited *Hydrodictyon utriculare*, from Sutton Park; also, *Chætophora elegans;* Mr. Hawkes, *Ceramium ciliatum* and *Dudresnia coccinea*.

THE FLIGHT OF BIRDS AND INSECTS.*

BY EDMUND CATCHPOOL, B.SC.

The question, "How do animals fly ?"—a difficult one to answer in any case—has been made much more difficult by two facts connected with it. One of these is that the study of flight lies on the border-land between the sciences of biology and physics, while those who have devoted themselves to it have usually been specialists in one only of these sciences. The other is the fact that there are two methods of flight, as distinct from each other as walking and jumping, and that from want of distinctive names these are often confused together. As an instance, one among many, of the first of these causes, let us take the common idea that birds are at least partly supported in the air by the possession, in the bones and other parts, of cavities filled with warm air. It is, of course, certain that this warm air, acting like that in a hot-air balloon, does to some extent support the bird ; and equally certain that this support never amounts to as much as the weight of a single quill feather on the bird. This result of a simple calculation from physical data disposes at once of the air-sacs as a practically important element in flight.

I will give another instance, which will help to clear the way to an understanding of the flight of birds. It is quite commonly believed that the feathers of the wings of birds open to let the air pass between them during the upstroke, and I have had it shown to me, by directing a jet of oxygen on the upper side of a wing, that when the pressure on this side exceeds that on the lower side, the feathers do open in this manner. This is quite true, but in flight the pressure never is greater on the upper surface, as a simple physical calculation proves. If the pressure on the upper surface was greater than on the lower, the bird would, of course, be unsupported during the upstroke, and would fall with the same velocity as any other unsupported body. In an upstroke, lasting $\frac{1}{8}$ sec., like that of the buzzard, the body would fall at least 3in., and, as observation shows that it does not, the pressure must always be greater on the lower surface.

I have begun with these two illustrations because in this paper I shall treat the subject of flight purely as a physicist. I do not pretend to be anything else, and I wish to show that

* Read before the Birmingham Natural History and Microscopical Society, January 8th, 1889.

there are some, at any rate, of the disputed points in the study of flight which can be solved by purely physical methods.

The fundamental fact in all flight, from a physical point of view, is the tendency of every flat surface moving in air to move in the direction of its own plane. This arises from the fact that any motion towards either side at once produces a compression of the air on that side, and so a resultant pressure nearly at right angles to the surface and in the direction opposed to the motion. The fact may be loosely but shortly expressed, by saying that every flat surface forced to move in air tries to move edgewise. Our experience of fans, cards, thin books, and the like, makes this tendency quite familiar. One way in which it may be used to support a body in the air is illustrated by a child's toy, once so popular as to earn the honour of the notice of "*Punch*." In this toy four plane surfaces of paper stretched on wire are fastened like the sails of a windmill to a centre, and the whole can be spun like a top with a piece of string. The four wings or sails are so set that, when spun, the higher edge of each is in front, so that each wing, tending to move edgewise, is urged upward, and the toy rises in the air until its velocity is spent. Or similar wings attached to one pan of a pair of scales, and made to rotate by a twisted elastic cord, will raise the pan to which they are attached. To make such a model fly by itself in the air something more is necessary, for if left free the other end of the elastic cord will untwist and the wings remain still; but as in the toy Japanese butterflies, the other end of the elastic cord is fastened to large stretched surfaces of paper arranged at right angles to the direction in which the elastic cord would turn them, so that there is a great resistance to its uncoiling at that end, or if, as in the original arrangement of Sir G. Cayley, that end is attached to another set of wings inclined in the opposite direction, so that these rotating the other way, may also tend to rise, we have an arrangement which will fly by itself, and differs in principle from a small insect in only one important respect.

An insect might, no doubt, be created which should fly exactly in this way; it is, indeed, mechanically a far better arrangement than that of actual insect's wings. But such an insect would have to be created; it could not grow. No part of any animal can rotate always in the same direction; the blood-vessels and nerves, which are necessary for its growth, would be twisted off. So, for locomotion on land, we have the alternate motion of legs, not the continuous rotation of a wheel; for the water, the oscillations of a tail, not the revolutions of a screw; for the air, vibrating wings, not the

revolving vanes of our model. These backward and forward motions are not the best, but they are for the animal the best possible.

In the actual insect, then, the wings must move backwards and forwards, not round and round, but the motion is still horizontal, not vertical like that of a bird's wings; the white blur seen when a fly balances itself in the air clearly shows this fact. As the wing surfaces must always be so inclined that the upper edge is in front, this inclination must change with the direction of the motion. In the insect this is managed automatically by the simple device of placing the surfaces vertical, and making the upper edge stiff, the lower thin and flexible; the resistance of the air to their motion then sets them in the required position, since it forces the flexible lower edge further back than the stiff upper one.

If we make a pair of wings by stretching thin paper over two thin strips of cane tapered to a point, and bent nearly at right angles near one end, these wings will resemble those of the insect in being stiff all along one edge and flexible along the other; and if we attach these to a frame, so that the cane edges are uppermost and horizontal, while the planes of the paper are vertical, they will be in a position like the insect's when it flies. If, by means of twisted elastic cord driving a crank and connecting-rod, we cause the strips of cane to move horizontally backwards and forwards like the oars of a boat, it will be seen that at each stroke the surface of the wing changes from a vertical to an inclined position. If this model is placed on one pan of a balance, and partly balanced by weight in the other pan, the pan containing it will rise as soon as the wings begin to move, showing, as might be expected, that these inclined surfaces tend to rise.

It will be seen that the principle of this model, and of the insect which it imitates, is really the same as that of the models with rotating wings, and that the adoption in the insect of an oscillatory instead of a rotary motion is a necessity not for flight but for growth; but it must not be supposed that it is as good an arrangement considered mechanically. All oscillatory motions are wasteful, and this waste becomes an important quantity whenever, from the nature or lightness of the structure, there is a considerable want of rigidity. In the insect the oscillatory movement is the cause of great waste of power. At the beginning and at the end of each stroke the wing is moving too slowly to bend the surface into the slanting position required; these parts of the stroke, therefore, exert no supporting power at all, and there are further losses from the want of sufficient rigidity in the nervures, which shortens the stroke without any corresponding diminution of work. So that while a set of sloping

wings, moving horizontally like those of an insect, but rotating always in the same direction (Sir G. Cayley's model, in fact), forms, probably, the most economical flying arrangement, for a given wing surface, which is mechanically possible, the reciprocating motion of the insect's wings, though on the same principle, is the most wasteful of all methods of flight in use, the energy required to support a given weight being, as appears from some not-too-satisfactory experiments of mine, between three and four times the amount that would be necessary if the same wings could rotate always in the same direction. A method so wasteful must be confined to the smaller flying animals, whose wings, enormously large in proportion to their weight, are a source of economy which balances this waste.

There is another reason why this method of supporting a weight in the air must be confined to small animals. Though this model with oscillating wings supports part of its weight when in motion, as shown by the rise of the scale-pan, it cannot be made to rise by itself, for even if made light enough, which would be difficult, the strokes are so slow that during each stroke the framework, which, of course, is acted on by a force equal and opposite to that which drives the wings, would acquire considerable velocity; in fact, the framework would move and not the wings. That in the insect the opposite is the case results from the extremely rapid reversals of the motion of the wings, and this sets a limit to the size of the animals which use this method of flight. For since (as may be shown mathematically) the velocity of the tips of the wings cannot be increased without great waste of energy, and the strokes cannot be shortened without a similar waste arising from the springing back of the wing at the end of of each stroke, it follows that the larger the wings the slower must be their vibrations, and hence the greater must be the oscillations of the body of the animal compared with those of the wings. Hence, this method of flight must be confined to creatures of small size.

The pressure of the air acts, of course, directly on the wings, which in their turn support the body, and the upward pressure on each wing increases with its increasing velocity from the beginning to the end of each stroke. So that, not being perfectly rigid, each wing rises a little during the stroke, and springs down again when it stops at the end, thus describing a kind of horizontal figure of eight (∞). This has been illustrated by Dr. Pettigrew, in his "Animal Mechanism," but it does not seem to have the importance he supposes—in fact, any wing not perfectly rigid must move in this way; that of the model described above does so, as may

be shown in a darkened room, by attaching a small piece of glowing charcoal to it. A small piece of gold leaf fixed with gum to the top of a fly's wing describes a similar curve. In order that an insect may advance through the air, the position of the wing surface, when not bent aside by the air, must be altered from a vertical plane to one sloping upward and forward. This might be accomplished by the whole insect assuming a more horizontal position, or by a change in the position of the wing itself, which might or might not be accompanied by a change in its motion. The observation of the change is very difficult, as the insect moves forward instantly when it takes place, but I incline to the view that the only alteration is a rotation of the wing round its stiff edge, so that it slants downwards and backwards from this edge instead of hanging merely downwards. In any case, it takes this position, and two distinct and independent results immediately follow. First, the pressure against the air being now directed downwards and backwards instead of merely downwards, the insect is urged forwards as well as supported by the motion of the wings. This would be the case just as much even if the insect's body was fastened so that it could not really move forwards. But besides this, the wing surfaces having on the average this upward and forward slant, the forward motion of the whole insect through the air causes them to tend to rise quite independently of their vibrating motion, so that there is a second supporting force which would still exist even if the insect ceased to move its wings, if only they were outstretched and the forward motion of the whole insect continued. I must be excused if I insist rather wearisomely on this point; it is a very important one, for it is by the development of this second and supplementary means of support that a method of flight is arrived at which is available for larger animals, and we have the possibility of the bird.

(*To be continued.*)

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, M.A., AND J. E. BAGNALL, A.L.S.

Sub-genus XXVII.—Crepidotus.

(*Continued from page 193.*)

247. **Ag. mollis**, *Schæff.* On logs. Aug.-Dec. On the foot of a bridge, in the black lands (Ipsley), *Purt.*, ii., 659. Hopsford, near Brinklow, *Adams.* Warwick, *Perceval.* Solihull, *Hawkes!* Sutton and Sutton Park; Packington Park.

248. **Ag. haustellaris,** *Fr.* *Ag. resupinatus,* With. On rotten wood, Packington Park, *With.*, 298. "Not observed since the time of Withering," *Berk. Outlines*, p. 164. Since recorded from Penzance (*Ralfs*), 1883.
249. **Ag. Rubi,** *Berk.* On rotten wood. Oct. Dunn's Pit Lane, Kenilworth, *Russell, Illustr.*
250. **Ag. pezizoides,** *Nees.* *Ag. campanulæformis,* Purt. On dead branches of trees. Rare. Feb. Near Pophills, *Mrs. Rufford, Purt.*, iii., 239. "Found only in Warwickshire," *Berk. Outlines*, p. 165.

Sub-genus XXIX.—Psalliota.

251.—**Ag. arvensis,** *Schæff.* In meadows. Aug.-Oct. *Ag. campestris*, var. 4. "Edgbaston Park, under large lime trees," *With.*, 226. Kenilworth, *Russell, List.* Fields, Ansty, *Adams.* School Close, *Rugby School Rep.* Sutton Park; Packington; Shustoke; Castle Bromwich, etc. This species has also occurred in cellars within the city of Birmingham on several occasions. "In the district east of Birmingham, where it is known as the 'Champignon,' it is freely eaten by certain country people; and I know a small village in the West Riding of Yorkshire of which the same is true, as doubtless of many others."—W. B. G.
252. **Ag. campestris,** *Linn.* Rich pastures. Frequent. Aug.-Oct. Warwick, *Perceval.* Fields about Ansty, *Adams.* Meadows, The Spring, Kenilworth, *Russell, Illustr.* Knowle, *Hawkes.* Packwood; Allesley; Sutton Park; Middleton; Coleshill; Sheldon. etc.

Var. *silvicola*, Vitt. Growing at the base of cottage, Field Gate Lane. Oct., 1874, *Russell, Illustr.*

Var. with *scaly pileus.* Rookery, Edgbaston, *With.*, 226. A form in which the pileus is covered with flattened pencils of brown hair, identical with that recorded by Withering, still occurs in Edgbaston Park.

The form *alba*, with beautiful silky white pileus, is common in Packington Park, and at Bradnock's Marsh. The var. *Ag. villaticus*, Brond., which is more likely to be a distinct species, was represented by grand specimens in a spinney at Hampton, on the edge of a meadow. These exactly agreed with Cooke, Illustr., pl. 585; the pileus measured over 12ins. in diameter, and the stem $2\frac{1}{2}$ins. in thickness.

253. **Ag. silvaticus,** *Schæff.* Kenilworth? *Russell, List.* ["I found this at the Leasowes, Halesowen, Worcestershire, in July, 1885."—W. B. G.]

Sub-genus XXX.—Stropharia.

254. **Ag. versicolor,** *With.* "This is a rare species. I found it only once, and then near the bridge in Edgbaston Park which goes over the stream that feeds the large pool," *With.*, 163. Not found since the time of Withering, either in Britain or, we believe, abroad.

255. **Ag æruginosus,** *Curt.* Meadows, etc. Common. Sep.-Nov. Rookery, Edgbaston! *With.*, 255. At the foot of the rails between Alcester and Oversley Bridge, *Purt.*, ii., 643. Crackley Wood! *Russell, Illustr.* Combe, *Rugby School Rep.* Solihull, *Hawkes!* Witton; Sutton; Middleton; Olton; Solihull; Coleshill Pool; Maxtoke; Packington Park; Marston Green, etc.

256. **Ag. albo-cyaneus,** *Desm.* Meadows and woods. Oct. Crackley Wood and Red Lane, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.* Bilton, *Rugby School Rep.*

257. **Ag. melaspermus,** *Bull.* Rare. Sept.-Oct. Heathcote Farm, Warwickshire, *Perceval.* Kenilworth, *Russell, Illustr.* The true *Ag. coronillus*, Bull = *Ag. melaspermus*, Fr., occurs in Sutton Park and at Coleshill Pool.

258. **Ag. squamosus,** *Fr.* Woods. Sept.-Oct. Rather rare. Kenilworth, *Russell, Illustr.* Sutton; Trickley Coppice, abundant. *Ag. thraustus*, Kalch., var. *aurantiacus*, Cooke, Illustr., pl. 555; Sutton and Packington Park.

259. **Ag. luteo-nitens,** *Fr.* On sawdust, etc. Rare. Crackley Wood, Kenilworth! *Cooke*, Grev. xiv., 37; Illustr., pl. 604.

260. **Ag. stercorarius.** *Fr.* On dung. Oct. On dung, pine wood, Coleshill Heath, Oct., 1884; Edgbaston Park.

261. **Ag. semiglobatus,** *Batsch.* On dung. Very common. Sept.-Nov. Crackley Lane, Kenilworth, *Russell, Illustr.* Common in fields, Ansty, *Adams.* Sutton Park; Middleton; Kingsbury; Marston Green; Coleshill Pool; Edgbaston; Olton, etc. "I have found, in Sutton Park, an *albino* form, with the gills white owing to the non-development of the spores."—W. B. G.

Sub-genus XXXI.—Hypholoma.

262. **Ag. sublateritius,** *Fr.* *Ag. fascicularis*, var. 2, *Purt.* Vars. 3 and 4, *With.* On old stumps. Frequent. Oct. Edgbaston, *With.*, 264. Ragley Wood, *Rufford*, *Purt.*, iii., 225. Warwick, *Perceval.* Crackley Wood! and Kenilworth, *Russell, Illustr.* Ansty, *Adams.* Sutton Park; New Park; Coleshill Pool; Kingsbury Wood near Three Pots, Watling Street; Umberslade, etc.

263. **Ag. epixanthus,** *Fr.* On stumps. Oct. Hopsford, near Brinklow, *Adams.* Sutton?

264. **Ag. fascicularis,** *Huds.* Old stumps. Very common. Oct. Edgbaston. *With.*, 263. Warwick, *Perceval.* Crackley Wood! *Russell, Illustr.* Ansty, *Adams.* Sutton Park; Coleshill Pool; Middleton; Kingsbury Wood, etc.
265. **Ag lacrymabundus,** *Fr.* Stumps, and on the ground. Oct. Footposts, Station Road, Kenilworth, *Russell, Illustr.* On banks, near Cut Throat Wood, Solihull; Alveston Pastures; near Stratford-on-Avon.
266. **Ag. velutinus,** *Pers.* On stumps. Aug.-Oct. Dale House Lane and Crackley Lane, Kenilworth, *Russell, Ilustr.* Fields, Ansty, *Adams.* Trickley Coppice; New Park; Marston Green; Olton; Packington Park; Langley.
267. **Ag. Candolleanus,** *Fr.* On stumps. Sept.-Oct. Shilton, near Coventry, *Adams.* Knowle, *Hawkes!* Trickley Coppice; Shawberry Wood, Shustoke; Solihull; Alveston Pastures; Langley.
268. **Ag. appendiculatus,** *Bull.* Stumps, etc. Oct. Cherry Orchard, Edgbaston, *With.*, 282. Oversley; Wixford, *Purt.*, iii., 230. Red Lane, Kenilworth, *Russell, Illustr.* The Fields, Combe, *Adams.* Aston Park; Sutton Park; New Park, Middleton; Bretnal Wood, near Atherstone; Packington Park; Penns; Shustoke, etc.
269. **Ag. egenulus,** *B. and Br.* Amongst grass. Oct. Spinney, near Newbold-on-Avon, *Adams.*
270. **Ag. hydrophilus,** *Bull.* *Ag. piluliformis,* Purt. In woods. Sept.-Oct. Ragley Wood, *Purt.*, iii., 234. Hopsford, near Brinklow, *Adams.* New Park, Middleton; Sutton Park; Trickley Coppice; Corley; Shirley." "I agree with those who consider *Ag. piluliformis* to be the young state of this species."—W. B. G.

(*To be continued.*)

THE FIN WHALE FISHERY IN NORTH LAPLAND.*

BY H. BALFOUR, M.A., F.Z.S.

(*Concluded from page 202.*)

First of all let me say that the methods adopted in the Finmarken fishery differ markedly from those of the Greenland and South Sea whalers. The Greenland Whale is searched for in large wooden sailing vessels, mostly barques of 400 to 500 tons gross, built for heavy ice work, with auxiliary steam power. When a whale is sighted close at hand, boats are launched, and the whale is harpooned from

these; formerly always with a harpoon thrown by hand, but now usually small swivel harpoon guns are used in addition, the guns being some 75lb. in weight.* The harpoons are necessarily somewhat small and light, and the whale-line measures only $2\frac{3}{4}$ inches in circumference. Poison has been tried in the South Sea fisheries with some success, as also small explosive bombs; but nothing of the nature of the formidable weapons used by the Finmarken whalers has been used elsewhere. It is only comparatively recently, in fact, that the Northern Rorquals have been regularly sought after at all, and this for various reasons.† Firstly they are far less valuable individually than the Greenland or Sperm Whales, and secondly they are extremely active and powerful, frequently of enormous size, far exceeding the dimensions of the Greenland Whale. They are, therefore, very dangerous to approach in small boats, which would stand but a poor chance if pitted against these vigorous animals. These were, however, some years back, extremely abundant along the north coast of Finmarken, and were seen in numbers close in shore, and even far up the larger fjords. Especially conspicuous was the huge Blue Whale (*B. Sibbaldii*), the most valuable of the Rorquals, which used to infest the Varanger fjord in large numbers.

It is now about twenty-three years since the enterprising Norwegian sailor, Svend Foyn, commenced a systematic pursuit of these animals. He obtained a monopoly of this fishery for some years, and conducted it on an entirely new plan. In 1882 other companies were able to engage in this then lucrative pursuit, and since then many companies have entered upon the business, and the whales are becoming scarcer and far more shy every year, having to be sought for much further afield than formerly. Svend Foyn's first factory was established at Vadsö, at the entrance of the Varanger Fjord, so much frequented by the Blue Whale, which at first was alone the object of pursuit. Since then this factory has been closed, and Foyn has moved his business westwards, as the fishery has become somewhat played out in these regions. The business is becoming very precarious, and companies frequently break up in consequence of poor seasons, or move their establishments elsewhere.

* Harpoon guns were first used in Greenland whale fishery about the year 1730.

† Scoresby, as long ago as 1818, made several attempts to capture the Blue Whale (*B. Sibbaldii*), but he met with no success, as his lines were invariably broken.

The vessels employed in the chase are small iron steamers of about eighty tons, with horse-power varying up to thirty-five or more. They are mostly about 80ft. long, though there is considerable variety in the dimensions, &c. They are good sea boats, and will stand a heavy sea, though they are washed over and over in even a moderate swell. The engine room is placed amidships, and there are two small masts. The foremost carries the "crow's nest," from which the harpooner keeps his look-out; it also carries the "accumulator" or relieving tackle, of which more anon. Each whaler is furnished with two to three small boats. In the extreme bows is situated a small cannon for firing the harpoon. This cannon is short and very thick, being often as much as 4¼ inches thick at the muzzle; its weight is usually about 15cwt., and it works upon a pivot, which allows of a horizontal rotary motion, and upon trunnions, which give a vertical play. There is a kind of pistol-stock handle held by the harpooner, who can thus aim in any direction with considerable rapidity, there being only a few pounds resistance to overcome. The charge is about ½lb. of powder, and the gun is fired usually by pulling a string, the recoil being minimised by means of indiarubber cushions behind the trunnions. Jutting out ahead of the gun, over the stem of the vessel, is a small platform, on which the harpooner can stand if necessary, and upon which part of the line is coiled, so as to run out easily when the gun is fired. The range is short (roughly speaking, about 12-13 yards).

Much interest, of course, centres round the harpoon, which is truly a most deadly weapon. I was fortunate in having presented to me one of the earliest patterns of this weapon, dating back to the commencement of Svend Foyn's experiments in improving the gun-harpoon. It is interesting to compare this with the modern form, which is a far more formidable weapon. This old harpoon is made entirely of iron, and is divided into three principal parts: (*a*) The head, which is comparatively large, and of pyramidal shape, with slightly concave sides. This is hollow inside, so as to contain a charge of gunpowder; the point is perforated and communicates with the chamber by means of a duct, which contains the fuse by which the charge was exploded when the head was buried in the whale's body. The head is screwed on to a worm at the end of (*b*) the lower part of the stock. This is rounded and thick, and carries two pairs of good-sized barbs, which work upon pivots at their bases, so as to lie close to the stock, and only open out when resistance is offered to a backward strain. This portion is also

perforated for the attachment of the line. Behind this is (*c*) the upper part of the stock, which is made in the form of four flanges at right angles to one another, or + shaped in cross section. This shape lightens this end of the harpoon, and has the same effect as the feather of an arrow, On to the end of this is fitted loosely an iron disc, three inches across, and fitting the bore of the gun. This takes the force of the explosion, and was, of course, lost when the harpoon was discharged. The weight of this harpoon is 12lb. It is quite obsolete, having long ago been superseded by improved patterns. My specimen actually belonged to a Dane, named Brandt, but may be taken as a type of Svend Foyn's early pattern of harpoon,

Foyn carefully studied the various designs of harpoons from different parts of the world, and spent large sums of money in constantly improving upon his own designs.

The modern harpoon, as in use to-day, is a great improvement upon the old model. The whole weapon, when ready for use, is about 6ft. long, and costs about £5 10s., and the stock alone weighs about 123lb. Beginning, as before, at the "business" end, there is first the sharp point, which has either two or three edges, and is three or four inches long. This acts as a "pilot" for the rest of the weapon, and is screwed into a large conical shell, 9in. long, and containing $\frac{3}{4}$lb. of gunpowder. This shell is screwed on to the end of the stock, which is perforated longitudinally by a small duct, in which lies a glass tube containing a fulminating powder, which communicates with the charge in the shell. Above this are two pairs of enormous barbs or flukes, pivoted at their bases. The lower pair are so arranged that when they open their bases meet inside and crush the glass tube, exploding the fulminating charge, and so also the charge in the shell, which is blown to pieces in the whale's body. Between the lower and upper parts of the stock is a large shackle, which shakes loose when a strong strain is applied, and prevents the stock breaking. The upper part of the stock is in the form of two stout bars, joined at the ends, and enclosing a space along which the grummet, to which is attached the line, can slide. This grummet is very strongly made of iron wire, of about fifty strands, strongly served round; to it the end of the line is spliced, The line is enormously strong, about seven inches in circumference, and is made in Norway of the finest Russian hemp. It is carefully tested to an enormous strain before being sent out. Each line is usually 120 fathoms, but several may be joined together. They are kept coiled up in huge bunkers in the forehold of the vessel.

The last important item which I have to mention is the "accumulator" or "relieving tackle." This apparatus is intended to minimise the bad effect of sudden jerks or strains upon the line. It is suspended from the foremast, and consists essentially of two cross-pieces, connected together with a number (12 or 15) of very strong indiarubber bands, which pass round them. The upper cross-piece is attached to the mast, and to the lower is fixed a wheel or metal block, over which is passed the harpoon line. A sudden jerk upon the line, caused by the whale starting off at suddenly increased pace, is reduced to a gradual strain by the stretching of the indiarubber bands, and a possible source of danger, or the breaking of the line, is thus to a great extent avoided.

When cruising about in search of whales the harpooner is stationed aloft in the "crow's nest," which is a very large tub placed high up on the foremast. From this post of vantage he has an extended view, and, when a whale is sighted, he gives the signal, and the vessel starts off in pursuit. The harpooner descends and takes up his station at the gun, with the pistol-stock handle in one hand and the firing cord in the other. When the whale is within range, about 12 or 13 yards, the gun is quickly brought to bear, and, usually as the whale rises across the line of sight, the string is pulled and the harpoon discharged. If the harpoon is "fast," the line runs out rapidly, and the steamer is soon being towed along; the engines are then reversed to full speed astern, so as to drag as much as possible, but in spite of this the vessel may still be towed along at a pace of eight or nine knots ahead. When a sufficient strain is applied to the line, the "flukes" of the harpoon break away from the lashings which secure them, and, as they open, crush the fulminating tube, and explode the shell inside the whale's body. Even then it is not necessarily "all up" with the beast, as it may still continue running for some time, often some hours, before finally succumbing. Mr. Cocks ("Zoologist," 1887) gives an interesting account of one whale which continued running for *six hours* from the time of its first being harpooned, in the course of which it towed two steamers along, with a harpoon from each in its body, both shells having properly exploded. This is certainly an exceptional example of endurance, but is a good instance of the enormous strength and great vitality of these animals. When the strength of the whale is spent, the steamer comes alongside, the boats are launched, and the men proceed to finish the work with lances, the shafts of which are enormously long. The beast usually gives a last convulsive struggle, known as

the "flurry," "screaming" loudly if it is a Humpback, and then it is all over. The next thing is to prepare the whale for being towed ashore to the factory, and for this the flukes are cut off, as they would impede progress. A chain or rope is then fixed just in front of the tail, and the whale is then towed tail first. At first the carcase shows but little above the water, but very soon it begins to swell up with gas, and floats higher and higher out of the water, till after the lapse of a few hours it is quite balloon-like and by no means "very like a whale." It may even burst with the pressure, and, if pierced in this condition, a loud report is often caused by the liberation of the confined gas.

The whale is thus towed to the company's factory, and it may be well here to give a brief description of this establishment. There is a large main building divided into two floors; the ground floor is given up to the huge boilers and tanks, where the oil is extracted by boiling and steaming from the blubber, &c. Into the upper storey is received the blubber as it is cut off, and leading up to this floor is a long slide, up which the pieces of blubber are drawn by means of a chain and windlass. In front of the factory is built a small pier, jutting out some little way into the sea at high tide; at the end of this is a crane, and on it are windlasses for hauling up the heavy bones, &c. The whale is hauled as high as possible up the shelving beach at high tide, usually head first; and, as soon as the carcase is sufficiently exposed by the falling tide, the operation of cutting up, or "flensing," commences. The men are armed with large knives, fitted with wooden handles about four feet long. A longitudinal incision is made at some part of the body, extending perhaps twenty feet, and another is made parallel to the first some two or three feet away from it; by means of transverse cuts a long piece of blubber is marked off, and a chain is then brought from a windlass at the base of the wooden slide leading to the upper storey. This chain is fixed to that end of the piece of blubber marked off, which is farthest from the the factory, and a certain amount of strain is applied by means of the windlass. The "flenser" then cuts away the connective tissue underlying the blubber, and the huge "blanket" piece is thus partly pulled and partly cut away, and hauled up to the base of the slide. Here the chain from the upper storey is fixed on, and the piece is dragged up the slide into the upper room, where it is divided up into smaller pieces for boiling down. The rest of the blubber is similarly removed, and the tongue is cut out and sent up the slide. The carcase is turned over at high tide, and the other side is

operated upon. The lower jaw bones are cut out, and the baleen plates removed to be divided up into the separate laminæ, and dried in the open. When all the blubber and other oil-bearing portions have been removed, the carcase or "crang" is towed off and sold to a guano factory, where it is converted into manure.

The oil procured is of different qualities, according to the part from which it has been obtained, that from the back of the Common Rorqual being reckoned the best; next in order comes that from the blubber of the belly and the tongue, and so on (see account in Mr. Cocks' paper).

In 1885 Norwegian "Finner" oil sold for £13 a ton; and in the same year Greenland whale oil sold for £22 a ton (formerly as much as £40), and Bottlenosed Whale oil £25 a ton (formerly £60). It is used for a variety of purposes; for burning, lubricating machinery, currying chamois leather, in batching flax, and in the manufacture of jute fibre, &c.

The whalebone, or baleen (called commercially "whale-fin"), procured from the Rorquals is very inferior to that of the Right Whales. That of the Blue Whale is more valuable than that of the other Balænopteridæ; the price last year being £180 a ton, and this was considered a fairly good price. Greenland Whale baleen will fetch £1,500 a ton or more, but the market prices vary enormously every year.

The otherwise rejected carcases with the bones are, as I have said, sold to the various guano factories, where they are converted into guano and glue. For guano the "crang" and bones are dried, ground, and mixed; some comes to England, but the greater part is sent to Hamburg, where the guano is subjected to chemical processes.

The bones are for the most part useless for manufacturing bone articles, as they are so porous, but from the outer portions of the lower jaw can be made various small articles, knitting needles, &c.

Another useful product of this industry is "whale-beef." Although this no longer ranks as a delicacy, still in former times it was considered as such. In the 12th to the 15th centuries, whale flesh was largely consumed by the Dutch, French, and Spaniards, and was sold in the markets of Bayonne and Biarritz, the tongue being especially favoured. Henry III. was particularly fond of it, and it appeared as a luxury at the municipal banquets. Whale flesh is not altogether scorned now-a-days. The "Xiania Preserving Company" tin large quantities of the flesh of the Rudolphi Rorqual, that of other species not being considered good. The Lapps frequently come down to

the factories, and are allowed to cut away huge pieces of the meat while the whale is being cut up; this they deposit in large tubs and add salt to it, to preserve it for winter consumption. They are not allowed to take the *fat* of the whales, but, nevertheless, if the foreman turns his back for a moment, they immediately pounce on the nearest lump of oily fat and carry it off in triumph.

Various dangers are incurred by the Norwegian whalers; explosions of gunpowder on board sometimes occur and cause serious damage; sometimes, too, the shell of the harpoon does not burst till the boats are alongside of the whale for lancing. In this way boats occasionally have been smashed in, and the crews placed in great danger. Whales occasionally do considerable damage, even to the steamers, by charging viciously, and, when we consider their enormous power and great activity, we can easily see that this is a serious form of danger. Besides these, various other risks are incurred which I need not mention.

In the course of a single paper I cannot expect to give more than the merest sketch of the whale fishery of these regions. The subject is one full of interest to the naturalist, as a vast amount with regard to the habits of the whales still remains to be discovered, and a few only of the Northern species of whales have been properly figured. Mr. Cock's papers in "The Zoologist" have done much towards drawing attention to this subject, and he has entered into detail upon many points to which I have been able to refer only in the briefest manner. His account of last year is not as yet published, but we may look forward to it with interest. Other attractions drew us away from the coast, after somewhat short visits to a few of the whaling stations. A journey into the interior of Lapland, up the Pasvig River to Lake Enare, had irresistible attractions; and, by the time we had returned to the coast, the whaling was over for the year. The factories were closed and deserted by the men, though one factory, which I visited again in Vardö on my return journey, presented nevertheless a very animated scene, as thousands upon thousands of seagulls, skuas, duck, and other sea birds were congregated there, on the beach and in the water, apparently busy enough over clearing away the rejected remnants of the season's spoils.

I append here for those interested in the subject a list of a few of the more interesting English papers dealing with the Northern Balænopteridæ:—

A. H. Cocks: Papers on the "Finmarken Whale Fishery," *Zoologist*, 1884, pp. 366, 417, 455; 1885, p. 134; 1886, p. 121; 1887, p. 207; 1888, p. 201.

W. H. Flower: "Notes on Four Specimens of the Common Fin Whale," *Proc. Zool. Soc.*, 1869, p. 604 and plate.

Robert Heddle: "On a Whale of the Genus Physalus," *Proc. Zool. Soc.*, 1856, p. 187. (Plates of Common Rorqual.)

R. Collet: "On the External Characters of Rudolphi's Rorqual," *Proc. Zool. Soc.*, 1886, p. 243; (two plates of this species; also engravings of *Balænophilus*, *Echinorhynchus*, and *Calanus*).

Robert Brown: "Notes on the History and Geographical Relations of Cetacea frequenting Davis Strait and Baffin's Bay," *Proc. Zool. Soc.*, 1868, p. 533.

Robert Gray: "Notes on a Voyage to the Greenland Seas," *Zoologist*, 1887, pp. 49, 94, 121 (plate of *B. mysticetus*); 1889. pp. 1, 41, 95.

E. Harting: "Distinguishing Characters of British Cetacea," *Zoologist*, 1878, p. 1.

Eschricht, *Reinhart*, and *Lilljeborg:* "Recent Memoirs on the Cetacea," *Ray Soc.*, 1866.

THE PETROLOGY OF OUR LOCAL PEBBLES.

BY T. H. WALLER, B.A., B.SC.

(Concluded from page 219.)

On examining a thin slice, however, a well-marked micro-granitic structure becomes visible, not of a very minute character, the individual portions of quartz and felspar being some ·001 to ·002 of an inch in diameter. The porphyritic crystals of felspar are all orthoclase. They are very cloudy, and in one or two places are invaded by the tourmaline, as if we saw the beginning of the process what has ended in the last-named pebble in the formation of a tourmaline aggregate replacing the entire felspar crystal. The tourmaline crystals are distributed along lines in the felspar substance, apparently the traces of what Prof. Judd terms solution planes, along which the alteration of crystals frequently takes place. Where the change is complete the banded arrangement is still visible, in such a way as if along these planes radiating masses of the tourmaline had penetrated into the felspar until the whole was a mass of interlacing crystals.

The tourmaline is not in most cases in the large crystalline masses previously mentioned, but much more minutely and confusedly crystallised. In one case long arms of crystals radiate from a centre, the axes of the crystals being parallel to the length of the arms.

The porphyritic quartz is crowded with relatively large cavities, frequently arranged in lines, which appear to be

continuous through two neighbouring grains without any trace of them being visible in the crystals of the ground mass. The arrangement of the quartz and felspar in this ground mass shows in places an approximation to pegmatite arrangement, and in some cases the boundaries of the quartz seem indented, as it were, by the quartz of the ground, as if the crystallisation of the latter had been regulated by the previously existing quartz.

The felsites which occur among our pebbles are of two or three principal types. There are reddish-brown quartz felsites, grey rhyolitic specimens, and others of the grey, and esitic type, which are so more plentiful in Wales.

(14) At Sutton, King's Heath, and also at Catspool, near Alvechurch, there occur pebbles of red quartz felsite, with, in most cases, abundant porphyritic quartz and felspar crystals. Many of the latter are still fairly fresh, and show bright cleavage faces on a fractured surface.

The micro-structure is very similar in all cases, the ground mass being a micro-granite of rather fine grain. The quartz has the deep bays and tongues of the ground mass running into the grains which are so common in the felsites. The felspar is partly at any rate triclinic, and in some sections not much is left but the mere outline or ghost of the crystal.

(15) A specimen collected at a little digging by the Keeper's Pool, at Sutton, on account of the large number of felspar crystals, the absence of visible quartz, and the presence of a good many flakes of black mica, presents a very different aspect from that of the felsites already mentioned, and we find that under the microscope the same differences are apparent. The felspars are to a very great extent unaltered, and both orthoclase and a plagioclase are present. The mica occurs in good quantity, and has sometimes undergone a change into a pale green substance, which also has replaced hornblende, the shape of the original mineral being retained.

The ground mass is very finely micro-crystalline.

In the next group of felsites we have still different structure.

(16) In a pebble, from Catspool, there is very decided flow structure in the ground mass, not straightforward streams, but presenting the crumpled up, damascened appearance, which denotes the attempt at mixture of two slightly different viscid magmas, becoming stiffer as they cool and are pressed on from behind by the flow of the mass. The quartz grains are small and numerous, and the felspar is much altered.

(17) A pebble (No. 37) from Sutton has porphyritic crystals of felspar almost perfectly fresh and transparent, and quartz containing in places beautiful glass cavities, with a bubble in each. The ground mass of the rock is spherulitic, passing in places into a micro-pegmatite of a clear mineral, which we may take to be quartz, and a dirty-looking substance, which probably represents felspar.

(18) In another pebble (21) from Blackroot Pool, Sutton, the appearance is such as we might imagine to be produced by the crushing and rolling out of such a rock as the last. The quartz grains are broken up into lines and strings, which have been recemented into continuous masses again, and the total aspect might almost be described as that of a gneissose felsite. That such has been the mechanical origin of the rock I do not, however, feel sure. The quartz contains many more fluid cavities, but they might be secondary. At the edge of some of the quartz the ground mass runs into it in a very peculiar manner, almost like the teeth of a comb, and a place or two exhibits a very fine cross striation in the arrangement of the components.

(19) By far the most curious specimen is from Catspool (No. 39). It has a somewhat gneissic look in the hand specimen, but without any very determinable foliation as to minerals. A thin section with a low power has a most wonderful similarity of aspect to a section of wood; the general lamination in the one direction being crossed by groups of browner parts almost at right angles. When examined with crossed nicols, the whole breaks up into areas of considerable size, which however do not polarise uniformly, but are subdivided again. All one of the larger areas may be on the whole dark, but the smaller portions which make obvious the longitudinal grain, so to speak, of the specimen may have various degrees of shading. No quartz is visible, the whole has very much the general look of a felspar which has been crushed out of shape.

Four specimens are exactly of the Wrekin type.

(20) One from Catspool (20) is exactly similar to the pale brown, finely flow-banded rock of the Wrekin itself.

(21) Another (13) from King's Heath is spherulitic, but not in very good condition; while

(22) A third (10) from King's Heath is precisely of the type of the splendid Lea rock specimens, but bleached to a pale yellow brown.

It presents the same spherulites with central quartz masses, often also with similar agate linings, the same microliths, and in a striking degree the very beautiful perlitic structure.

(23) A coarse ash from Catspool, might have come out of the quarry in the Lawrence Hill at the Wrekin. In addition to fragments of the spherulites as in the last specimen of fragments showing perlitic structure, there occur vesicular—or what has been vesicular—basalt apparently, the vesicles being now filled with a green mineral. Another fragment is andesitic in its character.

(24) The grey felsites I have principally met with on the southern side of the district, but a very greenish-grey rock, showing fine flow-banding, and occasional beautiful "flow" round included knots or crystals, was obtained at Hamstead. Another extremely similar, except in the absence of so many quartz grains and its rather less perfect flow structure, was collected at a little pit just by the tunnel, between Alvechurch and Tardebigg, at a place called on the Ordnance map Ox Leasows. The flow lines are accentuated by the presence of a greenish-blue mineral, with dichroism in many parts, changing to a pale yellow on rotating over the polariser. It certainly does not appear to have the very high double refraction of epidote, yet in its radiating habit of growth in the larger masses it has a good deal the appearance of this mineral.

(25) At Catspool was collected a beautiful grey felsite, with white spherulites all through it, plainly visible to the naked eye (No. 45).

The structure of the spherulites is not radial, but irregularly disposed brushes of crystals fill up the areas. They often include the minute crystals of felspar, which occur to a large extent in the ground mass of the rock. These are mostly very fresh and transparent, as are also the larger porphyritic crystals. The felspars are usually only simple twins, and do not show the repeated twinning characteristic of the plagioclases, but the fact that in a few cases symmetrical extinctions on each side of the composition plane were observed, proves the presence of plagioclase, which the angles observed would suggest to be oligoclase.

One of the larger felspar crystals shows extreme irregularity of outline; it has either been deeply eaten into by the still molten magma, or its growth was crippled.

(26) Of a somewhat different type is a specimen (44) which I found lying by the roadside on the road between Alvechurch and Blackwell.

In the hand specimen the ground mass is very similar in colour. Abundance of felspar crystals of $\frac{1}{8}$ to $\frac{1}{16}$in. long are visible, and a number of dark-coloured, elongated masses

running nearly parallel to each other through the rock give a well-marked flow structure to the specimen.

On a surface tangential to the flow they appear as broader plates.

Examined by the microscope in thin section they are of a rusty-yellow colour, and are composed of crystalline masses, the formation of which has apparently gone on from the edges. The substance has low double refraction and no visible dichroism, and seems to be what is generally called, for want of more knowledge as to its real nature, viridite. It has the appearance of filling cavities in the original rock.

The larger felspars are mostly striated, and are in fairly good condition.

The ground mass is mainly composed of interlacing felspar crystals of minute size, but among them are the appearances of a residual glass, now devitrified and showing a pale indefinite mosaic between crossed nicols.

(27) A thoroughly good gneiss (23) occurs among the Sutton pebbles. It is composed of quartz, felspar a good deal decomposed, and a pale mica.

In one part of the section lines of inclusions run almost all across the slide at nearly right angles to the foliation, showing their origin to have been subsequent to the formation of the gneiss.

(28) Of somewhat similar character is a pebble from Sidnal farm (49).

It is coarser in grain, but consists essentially of quartz felspar and white mica. The foliation is not by any means marked.

It contains a number of collections of black, quite opaque grains, which show no crystal form, and give no indication of their nature.

(29) A dolerite occurs at Catspool, and also in one or two other places in the district near (46).

It contains olivine, and differs from the Rowley Rag by being ophitic in structure.

At Sidnal farm the little gravel pit furnished, in addition to the rocks already mentioned, a very coarse conglomerate of quartz and felspar fragments set in a finer matrix. The felspar appears to be orthoclase, and shows wonderfully brilliant cleavage planes.

At Catspool a pebble of red granite, and one of a red syenite were found, and one of slate traversed by a quartz vein.

At the Ox Leasowes pit a mass of chert, with casts of encrinites, was found very similar to those which are met with at Sutton.

Some less determinable pebbles occur in all the various pits, but require much more examination.

I had hoped to have found in the nature of the pebbles some criterion by which the drift pebbles might be distinguished from those of the Triassic pebble beds. The data for such a discrimination are, I fear, not yet sufficiently numerous to make an opinion worth very much, but I think that the presence in a bed of the grey felsites, or pebbles of the type of the Wrekin rocks, would afford strong presumption of later age.

The striking feature of the Triassic pebbles is the abundance of tourmaline in several different forms of rock. Dr. Lapworth tells me that there is a marked absence of tourmaline in the chain of the Scandinavian Mountains. as well as in its British extension in Northern Scotland, while we know that tourmaline rocks are very abundant in Cornwall and Devon, and also in the remains of the Great Southern Mountain Chain more to the east, with which the rocks of those counties appear connected. It will be remembered that in the series of Norwegian rocks brought home by Mr. Pumphrey this summer, there were none containing any tourmaline, or, at least, none in which it was an essential constituent.

It appears, threefore, as if we might on the whole look to the great southern ancient range of mountains for the origin of the Triassic pebbles, but there is nothing to show from how far south the rivers came which brought them down. The absence, or at least very great rarity of granite, would indicate that at that time the deeper-seated portions were not yet bared by denudation. On the other hand, we have specimens of the felsites which so frequently form off-shoots from granite masses, and from their micro-granitic texture we may infer that we have more than the *most* superficial parts of the felsites. The quartzites also would naturally occur more on the outer flanks of the range rather than in the interior parts. On the other hand, the crushed and laminated condition of some of the rocks shows that the processes of elevation and crumpling were well advanced; that we have not, as it were, the washings of the earliest stages of the mountain-making period.

The pebbles mixed with this southern type in the upper gravel beds are much more distinctly of the character of the Welsh and lake country rocks. Granite is more frequent, and slate and gritty ashes occur which are quite wanting in the undoubtedly Bunter deposits. In addition, there is the marked difference between the types of felsites which has been noted above.

The indentations so frequent in the Triassic pebbles may, of course, and in fact do, survive when the disturbance of the beds at a later epoch has not been very great, but if we observe the actual beds, the correspondence of the pits on pebbles which are in contact prevents any mistake as to the age of the deposit.

As at the beginning of these notes, so now I again call attention to the very fragmentary character of what I have brought forward. The pebbles from Cannock and Kinver still have to be examined, although Professor Bonney has, of course, worked at the former locality. In such an investigation, more almost than in any other petrological work, "adventures are to the adventurous," or, rather, any worker may, at any time, come across a new piece of information, in the shape of a pebble, by no merit of his own, but simply by the fact of its not having been bared before.

At any rate I have shown that there are a fine series of rocks to be found by anyone even in our apparently uninteresting pebble beds.

Review.

The British Moss Flora. Part XII. *Fam. X., Grimmiaceæ II. Fam. XI., Schistostegaceæ.* By R. Braithwaite, M.D., 303, Clapham Road. 7s.

This part, which concludes the monograph of British Grimmiaceæ, contains forty-seven pages of letterpress and seven plates, with descriptions and illustrations of twenty-five species and twelve varieties, both descriptions and illustrations being characterised by the exactness and finish that have been peculiar to this work throughout. In dealing with the difficult genus Orthotrichum, the author divides the species into two sections, by means of the stomata to be found upon the walls of the capsule. Sect. 1, *Gymnoporus*, includes those species in which the stomata are superficial, the gourd cells being naked and visible. Sect. 2, *Calyptoporus*, includes those species in which the stomata are immersed in the wall of the capsule, and more or less covered by some of the epidermal cells. These bodies, which are abundant on the capsules of some species, form a ready means for separating nearly-allied forms, and the importance of this new feature in the diagnosis will commend itself to all students of this difficult group. The excellent illustrations which are given of the stomata peculiar to each species will be found very useful as aids to determination.

The genus Weissia, *Ehrhart*, follows this, and contains those species of the Orthotricheæ characterised by having leaves with plain margins, twisted when dry, and placed by the older botanists, Wilson and Schimper, in the genera Orthotrichum or Ulota, but Ehrhart's name, Weissia, has priority. The part concludes with a description and full page illustration of the pretty little Cavern Moss, Schistostega Osmundocea.

This part, which is one of the most helpful and valuable portions of the author's great work, completes one-half of the whole work.

J. E. Bagnall.

Wayside Notes.

Midland Union of Natural History Societies.—The annual meeting took place at Oxford on Tuesday and Wednesday, September 24th and 25th, but so close to the time of our going to press that our report of the proceedings cannot appear until November.

The Synthetic Philosophy.—Mr. F. Howard Collins, of Edgbaston, has for some years past been engaged in epitomising the ten volumes in which are contained all that is published of Mr. Herbert Spencer's Synthetic Philosophy. The arduous work is now completed, and will be published about the middle of October in a handsome volume. This epitome has been prepared with Mr. Spencer's hearty approval, and he has written an interesting preface to it. We shall review this important book in an early number.

Pupa anglica (Fer) in Carmarthenshire.—Several specimens of this species were sent me last year from near Langharme, in this county, by Mr. G. W. Mellors. The species is new to the county; the only previous Welsh record, I believe, is for Anglesey. The specific name *anglica* is here given instead of *ringens* (Jeff.), because it has priority and is the name now used in the National Collection.—J. W. Williams.

A Specimen of Paludina contecta (Mill) with a Double Peritreme.—In a batch of *P. contecta*, which Mr. Mayfield has kindly sent me alive, from Norwich, for dissecting purposes, I find one dead and empty shell which is worthy of note. The peritreme is double, each division being complete and divided from its fellow by a space of about 0·25 mill. I can get a fine probe between the divisions for the length of a millimetre; at this distance from the aperture the two divisions join. The inner division formed the aperture at the time of the death of the animal, as is evinced by the fact that it is more produced than the outer one. Unfortunately, the operculum is missing.—J. W. Williams, Mitton, Stourport.

Differences between the Embryonic Shells of Paludina vivipara (Linn.) and P. contecta (Mill).—The configuration of the shells of the young of our species of land and fresh-water Mollusca should be more studied, for often it is a hopeless task—to even the most experienced conchologist—to give a definite and positive answer to which a young specimen should be referred out of two or more species. The young forms of these two species under note are very different and characteristic. In *P. vivipara*, when the little animal is extracted, the shell is hyaline and unbanded, the spire is very depressed, the body-whorl is slightly globous and slightly keeled. Comparatively speaking the peritreme is large, and, though somewhat obliquely placed, is more at a right angle to the body-whorl than in the adult shell. The special feature is the great depression of the spire. In *P. contecta*, on the other hand, the young shell shows distinct traces of its future banding; the spire is not depressed, but characteristically elevated, the apex is sharp, the body-whorl globous, in a ratio with *P. vivipara* as 5-2, and the upper portion of the peritreme comes off from the body-whorl at a right angle. The operculum of *P. contecta* is more depressed at its centre than that of *P. vivipara*. The distinctness specifically of *P. contecta* and *P. vivipara* has been many times disputed, and is not yet laid to rest. I have examined a large number of the embryonic shells of these two species,

and were they specifically one and the same, I should certainly have expected to have found not one, but several, of them taken from *P. contecta* agreeing with those characteristic features of shell I have just enunciated as found in *P. vivipara*. I have never found one such, and I have carefully searched. And this, I hold, is a very good reason to believe in the specific distinctness of the two forms, no matter what the internal anatomy may be of the adult forms. No one can appreciate the striking difference of shell-form in the embryos of these two forms unless they see them.—J. W. Williams, 35, Mitton, Stourport.

In the North Warwickshire Cambrian Shales, at Chapel End, a bed of blue slate has been discovered. It is about 3ft. thick, and contains fossils. *Olenus*, *Agnostus*, &c., have been found. The dip is 54 degrees, same as the rest of the shales. This blue slate possibly indicates that the Warwickshire Cambrians are more nearly related to the Charnwood Rocks than has hitherto been supposed.—W. Andrews.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Microscopical Section Meeting, September 3rd, 1889. The President, Mr. W. B. Grove, M.A., in the chair. Mr. A. H. Martineau exhibited *Atticus pavonia major* (the Great Emperor Moth), from Ilkley, Yorkshire; Mr. W. B. Grove, M.A., *Agaricus lampropus*, from Sutton; and for Mr. W. R. Hughes, F.L.S., *Sphærotheca Castagnei* (the Hop Mildew); *Coleosporium Senecionis*, and *Polystigma rubrum*, from the south of England, and some of them under the miscroscope. Mr. S. Walliker, a large collection of Mosses, Hepaticæ, and Lichens from Germany, some of which were very fine, especially the Cladonias amongst the Lichens.—Biological Section, September 10th. Mr. W. B. Grove, M.A., in the chair. Mr. J. Udall exhibited *Drosera rotundifolia* in fruit from Stourport; also, for Mr. J. T. Blakemore, a hen's egg weighing ¼lb. Mr. W. H. Wilkinson exhibited the white variety of *Calluna vulgaris*, from Sutton Park, where the heather is unusually fine and abundant this year. Mr. Bagnall exhibited, for Mr. J. B. Stone, F.L.S., *Boletus edulis*, *B. scaber*, *Agaricus rubescens*, *Calocera viscosa*, and other fungi, from Rhyl; also, for Miss J. R. Gingell, *Drosera intermedia*, *Cuscuta epithymum*, *Hypericum elodes*, and other rare plants, from Cornwall; also, for Mr. Walliker, *Diphyscium foliosum*, *Pogonatum aloides*, and a number of other mosses, from the Riviera. Mr. Grove exhibited, for Mr. Oliver, *Polyporus vitreus*, from Edgbaston. Mr. J. Edmonds exhibited *Peltigera canina*, a foliaceous lichen, from Arley.—Geological Section, September 17th. Mr. W. R. Hughes, chairman. Exhibition of specimens. (1) Mr. J. E. Bagnall, for Mr. W. R. Hughes: A number of plants from South Devonshire, including *Anagallis cærulea*, *Calamintha officinalis*, *Erigeron acris*, *Aster tripolium*, &c. (2) Mr. J. E. Bagnall: *Silene anglica*, a rare colonist; *Russula heterophylla*, *R. depallens*, *Cantharellus aurantiacus*, and other fungi, from Coleshill. (3) Mr. W. H. Wilkinson: A collection of plants from Ramsgate district, including *Lepidium draba* (the hairy cress), *Hyoscyamus niger* (henbane), *Reseda lutea* (cut-leaved mignonette), also an abnormal form of Canterbury Bell, *Campanula Medium album*, in which the stem was much fasciated, and thirteen flowers combined into one long and folded bell; also a sponge, *Halichondria oculata* (Johnstone), from the shore near Sandgate, Kent.

Diagrams Illustrating Theories of Heredity

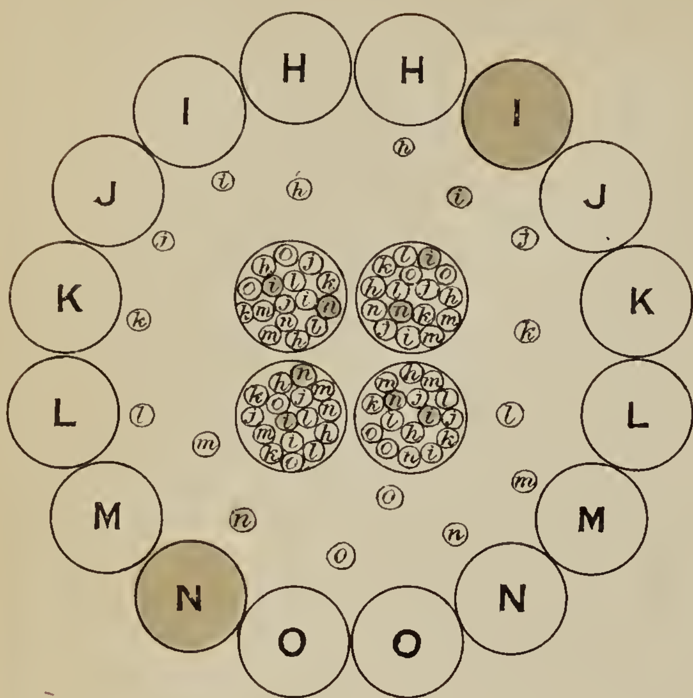
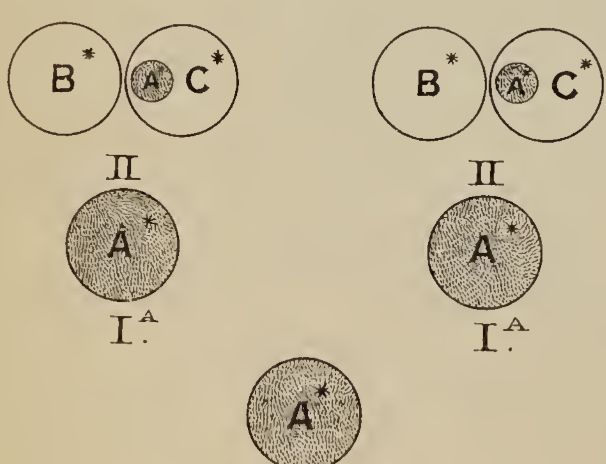


Diagram I.

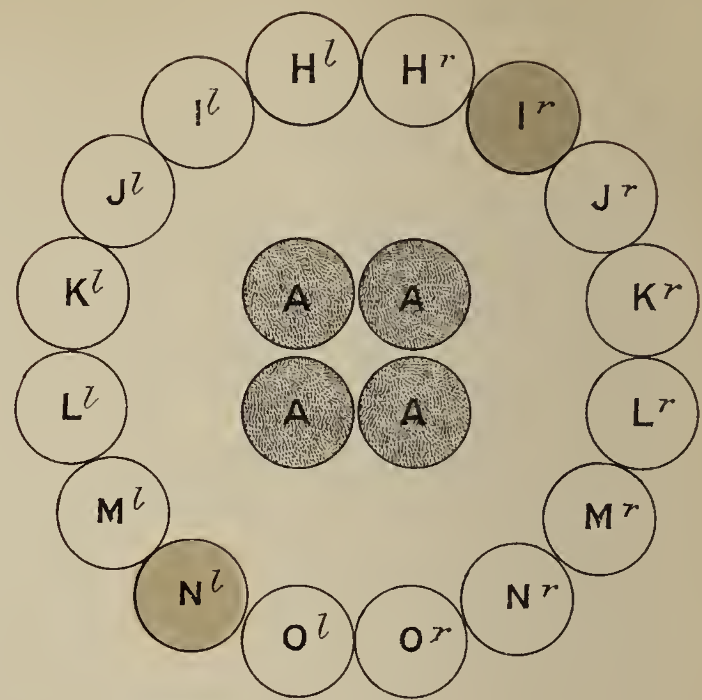
Pangenesis.



I.

Diagram III.

Development of Identical Twins.



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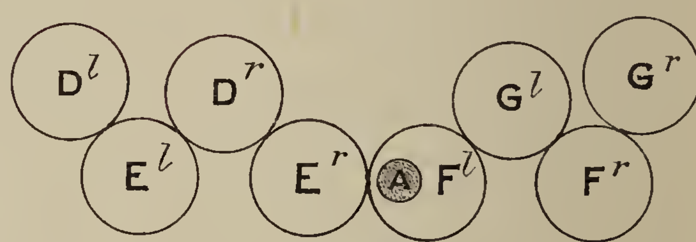

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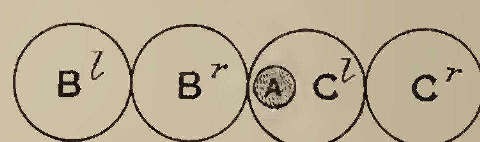

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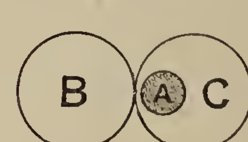

II.

I.

Diagram II.

Continuity of Germ-plasm

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THEORIES OF HEREDITY.*

BY E. B. POULTON, M.A., F.R.S.,

PRESIDENT OF THE MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

In order to understand the problem of heredity, it is necessary to have some general idea of the manner in which the higher organisms are built up. The lowest organisms (Protozoa and Protophyta), both animal and vegetable, consist of single cells, while all higher animals and plants (Metazoa and Metaphyta) are composed of cell aggregates. A single Protozoon does not represent a single Metazoon, but one of the generally innumerable units of which the latter is composed.

The higher animals are, however, something more than aggregates of cells; they are cell-republics, in which, at any rate in health, the structure and function of the units are subordinated to the good of the whole. Certain diseases are due to the literal *insubordination* of some of these units, which grow and multiply in defiance of that relationship in proportion and in the consumption of nutriment, which is necessary for the well-being of the whole. The surest hope of successful treatment lies in an early extirpation of the centre of insurrection. Later on, the centre will not only grow, but will despatch agents along the channels of communication, setting up other centres of mischief in distant parts of the body. Such a republic is not only liable to destruction from within by the revolt of its own members, but also by the successful attack of enemies from without. Numerous other forms of life are ever seeking to obtain a lodgment within it, and, if successful, discomfort, disease, or death, is almost invariably caused. The larger enemies, or parasites, have been known for ages; while the smaller, but far more dangerous foes, the germs of disease, have only been appreciated in comparatively recent times. Now, however, they attract a very large amount of attention, and the germ theory of disease is probably the most fruitful advance ever made in the history of medical and surgical science.

The cells, or units, which compose the body of one of the higher animals differ greatly in structure according to the

* Read at the Annual Meeting of the Midland Union of Natural History Societies, held at Oxford, September 23rd, 1889. [The Report of this Meeting, together with the discussion on the President's Address and the Annual Report of the Union, will appear in our next number.—Eds. M. N.]

part they play in the economy of the organism. Thus, in man, the upper skin, or epidermis, is composed of layers of cells, becoming horny scales on the surface. These cells are continuous with those lining the digestive tract and which pass up the ducts into the various glandular organs. The connective tissues which bind the various structures together and which make up many parts, such as tendons and the lower skin or dermis, are also composed of cells and fibrous elements derived from cells. The supporting tissues, bone and cartilage, are also composed of cells and structures derived from cells; and the same is true of the great contractile tissues, striped and unstriped muscular fibre, and of the elements of the nervous system—nerve-cells and nerve-fibres. Out of many of these elements the complex organs are built up, with the addition of peculiar or specific cells of their own.

All the varied units which compose the metazoan body may be classified under two chief heads. There are the cells which are concerned with maintaining the life of the individual—the *body-cells* or *somatic cells*; and there are those which are concerned with maintaining the life of the species —the *reproductive cells* or *germ-cells*.

In the higher animals, the latter are aggregated in a comparatively limited area, the reproductive organs (ovaries or testes). These can be removed in the operation of castration without essentially affecting the somatic cells. The life of the individual continues to its normal length under these circumstances, but the succession of individuals is entirely prevented.

The problem of heredity may be stated as follows:—How is it that a single germ-cell can produce, by repeated division, an organism in which the peculiarities of the somatic units of the parent are reproduced? A single cell separates from a small area in the body of the parent, but it controls the development of the offspring, so that the characters of every part of the parent are repeated with more or less accuracy.

It seems that there are only two possible ways in which this marvellous fact can be explained. First, the whole of the somatic cells may be so intimately connected with the germ-cells that each of the latter bears within itself the influence of the whole of the former—an influence, too, of such a nature as to lead to the reappearance of the corresponding somatic cell in the course of development; clearly, therefore, an influence of a material nature. Secondly, we may look upon the germ-cells as directly developed from the germ-cell from which the parent arose. Parent and offspring

would then resemble each other, because they are developed from the same thing, although at different times.

There is an essential difference between these two theories of heredity. In the first, the germ-cells may bear the impress of every event which happens to the somatic cells during the life of the parent, and such characters may therefore be looked for in the offspring; in the second, offspring and parent can only resemble each other in characters which were predetermined in the germ-cell from which the parent arose. These latter characters, the peculiarities of any somatic cell which follow from the structure of the original germ-cell, have therefore been called *blastogenic* by Weismann. They have also been called *spontaneous*, because they spring up in the individual without reference to the causes which operate during its lifetime; also *inherent* or *centrifugal*, because they belong to the essential nature of the individual, and because they may be looked upon as developing from within rather than as impressed from without. Conversely, the characters which appear in the somatic cells as the result of external influences, or as the outcome of their own special or unusual activities,—in fact, any characters appearing in the body which were not predetermined in the original germ-cell, have been called *somatogenic*, because their origin cannot be traced to the structure of the original germ-cell, but is entirely due to events brought about in somatic cells; they are also called *acquired*, because the individual comes to possess them, although they do not belong to its essential nature; and *centripetal*, because they are impressed upon the individual from without, and are not the outcome of internal causes.

It is my object to give a more detailed account of these two theories of heredity, and then to very briefly allude to some of the evidence which is believed to establish the hereditary transmission of *acquired* or *somatogenic* characters.

The first theory, maintaining that a close relationship of a material kind exists throughout life between somatic and germ-cells, was suggested by Darwin, under the name of Pangenesis.

This theory is illustrated by Diagram I., in which the large circles, indicated by the capital letters H to O, represent the somatic cells of a Metazoon, which, for the sake of simplicity, is supposed to be composed of only sixteen somatic and four germ-cells, the latter being placed in the centre. The somatic cells are arranged in pairs, H H, I I, &c., in order to indicate the fact that similar cells are generally found on opposite sides of the body in the higher Metazoa (bilateral symmetry).

The fact that each germ-cell, placed under appropriate conditions, will develop somatic cells like those of the parent, is explained by the supposition that all the latter cells give off gemmules, which are stored up in the germ-cells. The gemmules are represented in Diagram I. by the small circles marked with the small letters *h* to *o*. The gemmules are seen to be traversing the space which separates them from the germ-cells, and also stored up in the latter.

The space between the circle of somatic cells and the central germ-cells in the diagram is left for the sake of clearness : of course there is nothing corresponding to it in the body. The germ-cells are nevertheless localised, and the *distance* which the gemmules would be compelled to travel in order that, *e.g.*, the change in a brain-cell may be registered in a germ-cell, would be far greater than that represented in Diagram I.

With this hypothesis every somatic cell is a germ-cell, while the germ-cells proper are merely the meeting place for the germs of somatic cells. Because every part of the body is thus supposed to reproduce itself, Darwin called his hypothesis Pangenesis. Each germ-cell is supposed to be, as it were, an extract of the whole body; a microcosm, in which every cell that takes part in the composition of the organism is represented.

The first difficulty which this hypothesis encounters is the almost infinite complexity of a germ-cell which contains a material particle, a representative or gemmule, from every somatic cell of one of the higher animals. The countless number of cells in the human body may be imagined from the fact that it would require over ten million red blood corpuscles, lying flat, one deep, to cover an area one inch square. And yet every single blood corpuscle, although not exactly a cell itself, is the product of a single cell.

But this is not all ; for we must also suppose that each of the cells of every stage of development is also represented in each germ-cell, and is the material cause of the reappearance of such stages when the germ-cell itself undergoes development.

Nor is this all ; for we are also compelled to believe that gemmules from the cells of large numbers of generations of ancestors are present in many germ-cells, accounting for the facts of atavism or "throwing back." When an animal "throws back" to some remote ancestor, the gemmules must have been handed down in a dormant condition through all intermediate generations.

There are also practical difficulties in the way of the acceptance of Darwin's hypothesis. If it were true, we should

expect that mutilations, especially such as were inflicted early in life, would be transmitted to offspring ; for all the cell-generations later than the date of the injury would be absent, and therefore unrepresented by gemmules. But there is no evidence in favour of the transmission of mutilations, however early they may be inflicted. All the evidence when carefully examined points in the opposite direction.

Furthermore, in the process of transfusion, when the blood of one individual is replaced by that of another, it seems reasonable to suppose that, if the gemmules exist, many of them would be carried over, and would collect in the germ-cells of the individual which received the blood, and that thus some characters of one individual would afterwards appear in the offspring of another. Careful experiments, conducted by Galton and later by Romanes, prove that such transference of hereditary characters does not accompany the transfusion of blood.

Not only may blood be transfused, but various tissues may be grafted and will thrive on another individual, or even on a very different species. In these cases, too, we should expect that such transferred tissues would produce effects upon the offspring, for, according to the hypothesis, they would continue to give off gemmules. No such hereditary influence has ever been traced or even rendered probable.

When we enquire why Darwin was led to frame such a hypothesis, which, in spite of its great merit in connecting together a number of apparently isolated facts, has so much to be said against it, we find the answer in a reply to one of Huxley's letters, in which Pangenesis had evidently been adversely criticised. Darwin says ("Life and Letters," first edition, 1887, Vol. III., p. 44): "I do not doubt your judgment is perfectly just, and I will try to persuade myself not to publish. The whole affair is much too speculative; yet I think some such view will have to be adopted, when I call to mind such facts as the inherited effects of use and disuse, &c."

This opinion of Darwin's is as true to-day as when it was written (about 1865, exact date uncertain). If the effects of use and disuse are transmitted, the explanation must be sought for in a hypothesis constructed on the same lines as Pangenesis. But if we are mistaken in believing that such transmission occurs, a far simpler hypothesis will account for the facts.

The manner in which the transmission of such effects can be explained by the hypothesis of Pangenesis is shown in Diagram I. Two of the somatic cells, I on the right side and N on the left, are dark coloured. This is to represent some change which has been wrought in their structure by

the influence of an external force, or by some unusual exercise or practice of a part. Thus I might represent the change which occurs in a bone-cell when a bony growth has been caused by long-continued pressure; N might represent the change which occurs in a nerve cell when some new habit is acquired by long practice. Such altered cells would originate correspondingly altered gemmules, indicated by the same dark appearance, which would be stored up in the germ-cells, and would reproduce similarly altered cells in the offspring.

I have given a very brief account of the main features of the hypothesis of Pangenesis. It is a hypothesis which would explain the hereditary transmission of acquired characters. At the same time it is beset by difficulties which appear to be well-nigh insuperable.

We will now proceed to examine another theory of heredity, that of Professor Weismann. The theory is called "The Continuity of the Germ-plasm," the latter name being applied to the essential part of the germ-cell which determines its development into an individual. The word "continuity" is made use of to express the theory that heredity depends upon the fact that a minute quantity of this germ-plasm is reserved unchanged during the development of the individual, and subsequently grows and gives rise to the germ-cells. Hence the germ-plasm is continuous from one generation to another in an unending succession, and from it the germ-cells of each generation are produced.

The germ-plasm in a germ-cell possesses such a constitution that, placed under appropriate conditions, an individual of a certain species will be produced; but the germ-cells of this individual will also contain the same germ-plasm, and will therefore develop into offspring which resemble the parent. Parent and offspring resemble each other because both arise from the same substance, which develops rather later in the case of the offspring. Hence everything which is predetermined in the germ-cell, every blastogenic character, may be transmitted, while somatogenic characters cannot be transmitted.

The theory will be rendered more intelligible if we refer to Diagram II., in which the development of a Metazoon like that shown in Diagram I. is represented, according to the theory of the continuity of the germ-plasm. Development is complete in five stages, the number of the somatic cells being doubled in every stage, after their first appearance in the second. The first stage (I.) is the fertilised ovum, A, the single cell out of which all others are produced. It contains germ-plasm from two individuals, the combination being

the process of fertilisation. The germ-plasm is in reality only found in the nucleus of the cell, but this is omitted from the diagram for the sake of simplicity. The germ-plasm is supposed to be represented by the dots in the circle A.

The second stage (II.) is produced by the division of the ovum into two cells (B and C), each of which will give rise, by subsequent division, to one of two great classes of somatic cells. This is no theory: it rests upon many observations. When the subsequent history of each cell has been watched in certain animals, it has been found that different classes of cells have been produced. Hence, by the division of the ovum A, two cells are produced which are unlike each other and unlike the ovum; the process is not merely one of halving, but of differentiation. This is important to bear in mind, because halving sometimes occurs and leads to very different results, as will be seen below. But Weismann also supposes that a minute part of the germ-plasm in the ovum escapes the process of differentiation, and is carried unchanged in one of the cells of the second stage. It is represented as the smaller circle A, enclosed within C.

Not only are cells separated very early to form the great classes of somatic cells which will afterwards appear, but the sides of the body, and its hind and front ends, are also soon determined. It appears that, in some animals, the great groups of cells are determined by the first division; in others the right and left sides, or front and hind ends of the body; while the cells giving rise to the chief groups on each side would then be separated at some later division. This is not theory but fact; for Roux has recently shown that, if one of the products of the first division of the egg of a frog be destroyed with a hot needle, development is not necessarily arrested, but, when it proceeds, leads to the formation of an embryo from which either the right or the left side is absent. When the first division takes place in another direction, either the hind or front half was absent from the embryo which was afterwards produced. After the next division, when four cells were present, destruction of one produced an embryo from which one-fourth was absent.*

Hence either the great groups of cells or the sides or ends of the body may be predetermined in the first division of the egg; and we may feel sure that, although the order varies in different animals, *both* results occur very early. In Diagram

* My attention was first directed to these interesting experiments by Professor Windle's paper in the "Journal of Anatomy and Physiology," Vol. xxiii., p. 393.

II., merely as an illustration, the first division is represented as producing the precursors, B and C, of two great groups of cells, while the second division gives rise to Stage III. in which the right and left sides of the body are determined. (The hind and front ends of the body are omitted from consideration for the sake of simplicity.) Thus B splits up into Bl and Br, which are the precursors of one of the great groups on the left and the right sides of the body, respectively. C similarly becomes Cl and Cr, the precursors of the other great group on either side of the body. One of the latter, Cl, carries the unchanged germ-plasm, A, originally derived from the ovum.

At the next division eight cells are produced (Stage IV.), and subordinate groups are predetermined on both sides of the body. Thus Bl gives rise to two cells, Dl and El, the precursors of the two subordinate groups into which the chief group afterwards divides on the left side of the body. Br similarly divides and initiates the corresponding subordinate groups on the right side. Analogous divisions are undergone by Cl and Cr. In one of the products of Cl, viz., Fl, the unchanged germ-plasm is passed on.

The fourth division produces the fifth and last stage, the complete organism. Each of the eight cells again divides, producing sixteen cells, arranged as eight pairs. The body is, therefore, made up of eight different kinds of somatic cells, each kind being represented on both sides of the body.

The process may be summed up as follows :—In the first division, Stage II., one of the two chief groups of somatic cells, viz., H, I, J, K, on both sides of the body, was predetermined in B ; and the other chief group, L, M, N, O, was predetermined in C. At the second division, Stage III., the separation of these two chief groups for the right and left sides of the body was determined. Bl became the precursor of Hl, Il, Jl, and Kl ; Br of Hr, Ir, Jr, and Kr, and similarly with Cl and Cr. At the third division, Stage IV., the separation of the two chief groups into subordinate groups on either side of the body was predetermined. Thus Bl gave rise to Dl and El, the precursors of the subordinate groups Hl, Il, and Jl, Kl respectively : similarly with the others. Finally, in the last division, Stage V., each subordinate group again separates into two kinds of cells, thus making eight different kinds altogether.

This is a very imperfect attempt to realise by an appeal to diagrams the course of development in a Metazoon. The imperfection lies chiefly in the simplicity of the illustration as contrasted with the inconceivable complexity of the actual

process. Many facts, however, seem to show that the *principle* of development is correctly indicated in the diagram.

At about the time of the last division we must suppose that the minute mass of germ-plasm, A, grows and separates as a germ-cell or germ-cells from either Fl or one or more of the somatic cells into which the latter divides. The four germ-cells of the adult Metazoon are then produced by division. These germ-cells are, therefore, similar to that which started development; they are, in fact, a piece of it, which has grown without undergoing any essential alteration. The development of these four germ-cells will, therefore, produce offspring resembling their parents.

If, however, some of the somatic cells become modified from that nature which was predetermined in the germ-plasm of the ovum, there is no way in which the hereditary transmission of such effects can be explained by the theory of the continuity of the germ-plasm; for the theory does not include any means by which the effects could be conveyed to the germ-cells, or, if conveyed, could produce in them changes such that similar effects would be predetermined in the corresponding somatic cells of the offspring. The acquired changes in Ir and Nl, indicated by their dark colour, would be confined to the organism in which they arose, and would not affect its offspring, at any rate in a corresponding manner.

If the transmission of acquired characters were proved to be an undoubted fact, Weismann's theory of heredity would inevitably collapse. It cannot, however, be maintained that such proof is yet forthcoming.

The question largely turns upon an exact knowledge of the proportion borne by blastogenic to somatogenic characters. We know how important a share of our physical and mental qualities are hereditary. It would, therefore, follow, if Weismann's theory be correct, that blastogenic characters are far more important than somatogenic.

There is some evidence that this is the case, and I will here bring forward one line of proof, because it also supports the conclusion alluded to above, that the whole organism is predetermined in the ovum.

If this last conclusion be valid, it follows that the differences which characterise individuals are predetermined in the ova from which they arise, that ova are not alike any more than individuals. We do, however, occasionally meet with individuals so much alike that we (incorrectly) speak of them as "identical." The resemblance between certain twins is far closer than that between other members of the same family. If, therefore, we can prove that such "identical"

individuals are derived from "identical" ova, the above-mentioned arguments and conclusions will receive very strong support.

"Identical" twins are invariably of the same sex. When twins are of different sex, the degree of resemblance is no greater than that between brothers and sisters generally. This is also true of many twins of the same sex, and Galton has brought forward evidence to show that they may even differ more widely than is usual with brothers or sisters.

It has been long known that twins of the same sex are often enclosed in the same embryonic membranes, while twins of opposite sex are always enclosed in separate membranes. The latter would be the product of distinct ova, which had been separately fertilised, as in the ordinary multiple births of animals (cats, dogs, rabbits, &c.). The former would be the product of a single ovum, which has divided into two ova, in all probability after fertilisation. But it is clear that the ova arising from the two halves of a single ovum, at a time when the individual characteristics were already determined, would be very nearly identical: their resemblance would be of a very different order to that of separate ova. We also find that twins of the same sex present resemblances of a very different order to that of brothers or sisters generally, who are developed from separate ova. It must be admitted, therefore, that there is a very high degree of probability that the "identical" ova are those which develop into the "identical" individuals. The interesting conclusion that sex is also predetermined in the fertilised ovum also follows from the same facts.

The probable beginning of the development of "identical" twins is shown in Diagram III. A* is a fertilised ovum with the individual characteristics predetermined; it is, therefore, different from A in Diagram II., and is distinguished by the asterisk. At its first division A* does not form the cells of Stage II., which, it will be remembered, are different from each other and from the ovum; but it divides without differentiation into two equivalent cells, like each other and like the ovum. Hence the first division of A* does not produce Stage II., but Stage Ia, consisting of two similar ova. Each of these then divides, as in Diagram III., forming a true Stage II., comparable to that of Diagram II. After this the other stages succeed as in the latter, and finally two individuals will be formed, which must resemble each other if it be true that individual characteristics are predetermined in the fertilised ovum. And, as a matter of fact, such resemblances are seen in individuals whose development may be considered,

with a very high degree of probability, to have followed the lines indicated in Diagram III.

The amount of resemblance has been shown by Galton,* who traced the after life of about eighty "identical" twins as far and as completely as possible, obtaining instructive details in thirty-five cases. Of the latter there were no less than seven cases "in which both twins suffered from some special ailment or had some exceptional peculiarity;" in nine cases it appeared "that both twins are apt to sicken at the same time;" in eleven cases there was evidence for a remarkable association of ideas; in sixteen cases the tastes and dispositions were described as closely similar. These points of identity are given in addition to the more superficial indications presented by the failure of strangers or even parents to distinguish between the twins.

When the lives of twins were followed in after years "in some cases the resemblance of body and mind continued up to old age, notwithstanding very different conditions of life." In other cases "the parents ascribed such dissimilarity as there was wholly, or almost wholly, to some form of illness."

The conclusions of the author are as follows:—"Twins who closely resembled each other in childhood and early youth, and were reared under not very dissimilar conditions, either grow unlike through the development of natural characteristics which had lain dormant at first, or else they continue their lives, keeping time like two watches, hardly to be thrown out of accord except by some physical jar. Nature is far stronger than nurture within the limited range that I have been careful to assign to the latter." And again "where the maladies of twins are continually alike, the clocks of their two lives move regularly on, and at the same rate, governed by their internal mechanism. Necessitarians may derive new arguments from the life histories of twins."

Mr. Galton also met with twenty cases of twins (also of the same sex) in which the differences were greater than those which usually distinguish children of the same family. In such twins the conditions of training, &c., had been as similar as possible, so that the evidence of the power of nature over nurture is strongly confirmed. Mr. Galton writes, "I have not a single case in which my correspondents speak of originally dissimilar characters having become assimilated through identity of nurture. The impression that all this evidence leaves on the mind is one of wonder whether nurture can do anything at all beyond giving instruction and professional training."

* Journal of the Anthropological Institute, 1875, p. 391 and p. 325.

The argument thus leads to the conclusion that nearly everything which is characteristic of an individual is blastogenic, and therefore can be transmitted by the continuity of the germ-plasm. We can thus appreciate Weismann's contention that natural selection, while seeming to decide between successful and unsuccessful individuals, is in reality deciding between successful and unsuccessful germs.

Monstrosities can be satisfactorily explained, in the same manner as "identical" twins, by the occurrence of an equivalent division instead of a differentiating division of the cell which, at some stage of development, is the precursor of the doubled part. It has already been shown that when the ovum of a frog divides in a certain direction, one cell is the precursor of the future front half of the body, the other of the future hind half; for if one of them be destroyed the corresponding half is absent. Similarly, if one of them underwent equivalent instead of differentiating division, a monster with two front parts or two hind parts would be produced.

During the vast succession of differentiating divisions which take place in the development of one of the higher animals, the cells which represent parts of less and less importance are gradually told off. Thus, each finger and toe might be represented by a single cell at some period of development; and if one of these underwent equivalent divison, such a simple monstrosity as the occurrence of a supernumerary digit would be accounted for.

The facts are in reality more complex than appears in this description; for I have only considered the differentiating divisions which are concerned with producing the various parts of the body, and there are also the other differentiating divisions which produce the various groups of cells found in each part. Taking these into account also, we see that each finger would be represented by a single cell for each of the great groups of cells which will take part in its constitution. These cells must all undergo equivalent division, for we find all the groups of cells represented in each of the two parts formed in a double monstrosity.

It must be remembered that in such a case the fertilised ovum possessed such a structure as to predetermine an equivalent instead of a differentiating division at that particular point. And we know that such monstrosities are in the highest degree hereditary, as they would be if the germ-plasm were continuous.*

* See Professor Windle's interesting papers on Teratology, published during the last few years in the "Journal of Anatomy and Physiology," and the "Proceedings of the Birmingham Philosophical Society."

Repair, and the renewal of lost parts in certain animals, is also explained by the persistence of the cells which were the immediate precursors of that part or tissue;—cells which would be ready to pass through the last stages of development under the stimulus provided by an injury.

The simplicity and beauty of Professor Weismann's theory of heredity commends it to our favourable attention, and demands a searching enquiry into the evidence for the supposed transmission of acquired or somatogenic characters.

Into this enquiry it is impossible to enter on the present occasion. I will only mention the various lines of evidence which require investigation. The evidence may be either Direct or Indirect. Direct proof would be afforded if an undoubtedly somatogenic character could be shown to have reappeared in the offspring sufficiently often to prevent its explanation as a coincidence. Thus, if mutilations, or the pure results of training, exercise, or education (as apart from predisposition), or acquired diseases (many diseases are certainly blastogenic) reappeared in the offspring as the result of the operation of heredity, the required proof would be afforded and the theory of the continuity of the germ-plasm would collapse. Many diseases are due to living organisms ("germs"), and when these reappear in the offspring the result is clearly due to inoculation of the embryo or even the germ-cell (as in the silkworm disease), and is not therefore due to the operation of heredity.

The present adverse position of the medical faculty is in part due to want of discrimination between blastogenic and somatogenic characters; in part to the fact that the evidence on which they rely was collected when the transmission of somatogenic characters was assumed by everyone; and in part to real difficulties which, however, require the most careful re-examination before they can be accepted as proofs of the transmission of acquired characters and as the death-blow to Weismann's theory.

If the Direct evidence for the transmission of acquired characters fails to stand the ordeal of a thorough investigation, the Indirect evidence still remains. If it could be shown that certain phases of evolution would have been impossible *without* such transmission, we should be compelled to maintain that the latter had taken place.

The chief lines of Indirect evidence are:—The fact of individual variation, the effects of use and disuse of parts, the facts presented by the phenomena of instinct.

Individual variation was believed to be due to the hereditary effect of the direct action of environment. It is known that in some cases (*e.g.* certain plants) variation has been caused by the direct action of environment on the germ-cells while still contained in the body of the parent. Such a change is, of course, blastogenic, and would be transmitted. There is less evidence for the operation of such causes in the case of animals. The consideration of twins and monstrosities pointed to the conclusion that individual variation is predetermined in the fertilised ovum. If it be asked how such differences between ova are produced, Weismann has pointed out that there is some evidence that the changes which ova and spermatozoa undergo, as a preparation for their fusion in fertilisation, must lead to individual differences. He, therefore, considers that variation is produced by sexual reproduction, and is, in fact, its *raison d'être.* The meaning of this form of reproduction is to supply variations upon which natural selection can operate.

The apparent effects of increased use are more probably due to the operation of natural selection upon a part which is, *ex hypothesi*, of especial importance, combined with the admitted increase which follows increased use during the life of the individual. The apparent effects of disuse are more probably due to the cessation of natural selection, which can no longer maintain the efficiency of a useless part. All functional parts of an organism are kept up to a high standard by the operation of natural selection; withdraw selection and degeneration will at once begin. It is very interesting to find that both Galton and Weismann independently arrived at the conclusion that this offered a *better* explanation of the gradual dwindling of useless parts, than that afforded by the supposition that the admitted dwindling which follows from disuse during an individual life is transmitted.

Finally, the phenomena of instinct seem capable of explanation by the operation of natural selection upon blastogenic variations of the nervous system, rather than by the supposed transmission of acquired habit. In many cases we are compelled to adopt the former theory, and it is open to us in all.

I have not really attempted any discussion of the transmission of acquired characters. I have only indicated the chief lines along which the discussion has been and will be directed.

THE SYNTHETIC PHILOSOPHY.*

BY GRANT ALLEN.

Every Midland naturalist, it is to be hoped, has long before this read Mr. Herbert Spencer's "Principles of Biology." Not to have done so is to remain in the dark ages of pre-Darwinian thought. That great work forms, indeed, the foundation of the science of life in its modern development; and to rest ignorant of it is to ignore contentedly what the most fertile of our thinkers has had to say about the kernel of our own particular subject. *Noblesse oblige*: and much is expected of Midland naturalists. Yet. great as the Biology is in itself, it becomes even greater still when viewed as a component part of the vast and harmonious fabric of the Synthetic Philosophy. Fully to understand the book, it must be taken as succeeding the "First Principles," and as leading up to the "Principles of Psychology." And, if we wish to gain a clear conception of animal life, at least, in its total manifestations, we must have read the account of the evolution of nervous systems given in that part of the Psychology entitled "Physical Synthesis," as well as the account of the evolution of other structures and functions given in the morphological and physiological parts of the "Principles of Biology." The naturalist's world cannot well be isolated from the rest of the great universe of which it forms one important component element. As part of a whole itself, its philosophy can only be rightly grasped in connection with the philosophy of the cosmos which embraces and includes it.

Mr. Spencer has fully impressed upon our generation this profound truth, and has illustrated it himself in his wonderful life-work. But not to all men is it given to follow him equally through all the fields of thought his architectonic mind so impartially traverses. Many of us would at least like, as Mr. Spencer himself puts it, "a small outline map;" and in the small outline-map we can more readily find our way on a first exploration than in the detailed plan, or in the intricacies of the actual country to be travelled. Such a map Mr.

* "An Epitome of the 'Synthetic Philosophy.'" By Howard Collins. With a Preface by Herbert Spencer. (London: Williams and Norgate. 1889.)

Collins has prepared for us with infinite patience. skill, and labour. He has gone through the ten published volumes of the "Synthetic Philosophy," part by part, chapter by chapter, section by section, paragraph by paragraph, and has given us the gist and kernel of each, at the uniform rate of three lines to each page of the original, with a success that really surpasses belief. To say that any man has epitomized another with such mathematical regularity sounds at first hearing as if he must have taken all the life and colour out of his author's work—as if the result must be a purely dull and mechanical copy of a living whole. Nothing could really be further from the truth. Mr. Collins's summary is both truthful and readable; it contains in brief every leading thought or argument of the original, but it contains it in a form scarcely less vivid than Mr. Spencer's first presentment. Only a reader who thoroughly entered into his author's meaning could so impartially represent in brief so vast a body of propositions on so many varied subjects. Mr. Collins is to be congratulated on having succeeded so well, and in having obtained from Mr. Spencer himself the high commendation of an introductory *imprimatur*.

For the student, the great value of the summary now set forth will be its use as an aid to the anticipatory reading of the "Synthetic Philosophy." Before tackling any particular one of those wonderful volumes, he will do well to read over carefully at full length the whole of Mr. Collins's epitome of its contents by gradual stages. He should then begin, chapter by chapter; and, before reading each, should peruse the corresponding portion of the epitome. In the same way, each paragraph should be looked up in the epitome beforehand, so that the train of thought and the tendency of the argument may be clearly appreciated. Finally, at the end of each part, the whole corresponding portion of the epitome should be re-read in a lump, so as to recall to the mind vividly the course of the thread of thought through the entire distance just traversed. This may seem to lazy people a painfully serious way of going to work; but, then, the "Synthetic Philosophy" is a serious undertaking, and if ever a book was worth reading with care, many times over, surely it is this highest and widest product of the human scientific and philosophical intelligence. A great thinker has been born among us. Let us accept with gratitude the work he has done himself, and all the aids that others have given us in understanding and elucidating his orderly arrangement of the vast chaos of materials Nature presents to the observing intellect.

THE FLIGHT OF BIRDS AND INSECTS.

BY EDMUND CATCHPOOL, B.SC.

(Concluded from page 225.)

If, as I have tried to make clear, an insect when moving forwards is partly supported by that motion, as well as by the vibration of its wings, it follows that it is easier for it to fly forwards than to remain in one place in the air, and it is easily shown by experiment that this is the case. If we catch a bluebottle fly, and cut away the hinder two-thirds of each wing (so as to leave the front rib with about one-third of the original surface attached), we shall find that it can no longer balance itself in the air, nor, if placed on the ground or on a table, can it rise; yet, if dropped from a height of a few feet, though it cannot at first support itself, yet the active vibration of the remaining portions of its wings soon gives it a forward motion, and as this becomes more rapid the fly falls less and less rapidly, then moves forward horizontally, without falling, and, finally, takes an upward slope, reaching the window, perhaps, at a higher point than it started from. Here we see not only that the forward motion helps to support the insect, but that this support is obtained with less expenditure of strength than the same amount obtained by the vibration of the wing alone, since the fly is not strong enough to support itself, with its diminished wing-surface, by the latter method. It is easy to see why; for the upward pressure resulting from the continuous forward motion is a continuous pressure acting always on the same side of the wing, and is, therefore, subject to none of the losses from want of rigidity and change of direction, which, as I have pointed out, waste much of the energy expended in the vibratory motion of the wings. We see, then, that a fly, when its wings are partly cut away, is forced to economise its strength under this disadvantage by using the vibration of its wings to propel it, instead of only to support it, and taking advantage of the support which its forward motion gives it. Now, the fly's wings, so reduced, are still more than eight times as large in proportion to its weight as those of a pigeon, and nearly twenty times as large in proportion to its weight as those of an albatross. The wings of a pigeon, to be as large in proportion to its weight as those of a gnat, must be nearly 6ft. each in length, and wide in proportion. And the bird, though rather stronger in proportion to its weight than the insect, is not much stronger; probably not half as strong

again. (The widely prevailing idea that insects are enormously strong in proportion to their weight can be shown, I think, to be a fallacy, resulting from a misconception of what increased strength, with proportionately increased mass, ought to effect.) So that it is certain that the bird must use the most economical method of flight available. Now, we found that a fly, forced by the reduction of its wing-surface to greater economy of strength in flying, was still able to fly if it turned its wing-surfaces into an oblique position, moved them obliquely instead of horizontally, and, using them thus as propellers as well as supporters, took advantage of the upward pressure arising from its forward motion. It is evidently only a further step in the same direction to place the wing-surfaces nearly horizontal, and move them vertically. In this case the pressure of the wings on the air is directly backwards, and does not support the insect at all; the whole support is derived from the gliding of the wings, sloping a little up in front, on the air. This seems to be the principle of the flight of the larger insects, of bats, and of birds.

If we examine the wing of a bird, we find that it consists of two distinct parts, though they are not always separated by a distinct line. The part nearer the body of the bird consists of feathers which are divided nearly into equal parts by the ribs, are directed backwards along the bird, and overlap so that no air can pass between, at least from below. The outer part, that furthest from the body, consists of feathers which, when the wing is outstretched, are nearly at right angles to the body, and separate from one another like the outspread fingers of a hand, and consist each of a flexible surface supported by a stiff rib which runs very nearly to its front edge. Each of these outstretched feathers, then, is stiff along its front edge, and flexible along its hinder one, and it is easy to see that, as it is moved up and down, the resistance of the air will always set it in such a position that, if it tries to move edgewise, it will tend forwards. That, as a matter of fact, each of these feathers does act as a propeller, can easily be shown by fixing two of them to a clockwork arrangement which makes them move up and down as they do on the bird, and which is suspended from a small carriage which can run along a horizontal string. As soon as the feathers begin to move up and down, the carriage runs forward along the string; and that such a propelling power as these feathers furnish is all that is necessary for flight, is shown both by the fact that a bird can support itself in the air simply by holding its wings outspread as long as its forward motion lasts, and could therefore do so indefinitely with the aid of a propelling

force. This can be shown by a simple experiment. If we bend a piece of cane into a bow, cover it with paper so that it forms a crescent-shaped surface similar to that offered by the outstretched wings of the bird, we find that it will glide forwards on the air just as a bird does, and if it is furnished with screw propellers, like those of a steamship, driven by an elastic spring, it will continue this gliding motion till the spring is run down.

Such a model as this makes very clear the two distinct functions of the wing: propulsion and support. The propulsion must be the work of the long outer feathers, for the others, besides being unfitted for it by structure and arrangement, do not move up and down far or rapidly enough; the support, which in this method of flight continues when the wings are merely extended, is especially the part of the continuous surface formed by the overlapping feathers nearer the body. It is, indeed, only for convenience that these move up and down at all; as our model shows, if the propelling feathers could move up and down while the inner part of each wing was merely outstretched, the resulting flight would be the same.

It will be noticed that in the smaller insects, which support themselves entirely by the motion of the wings, almost the whole of the wing-surface is at the end remote from the body, since only at the end of a long arm can it be moved through sufficient air in each stroke to make it effective. Where the support is afforded by the forward motion of the whole animal, as in the larger moths and all birds, every part of the wing serves equally for support, and the largest part of the surface is, therefore, near to the body, as being the position in which it can be supported with least material.

Now, let me recapitulate. The typical insect flight, that is seen in perfection in small insects such as gnats, when hovering in still air, is effected by putting the wing-surfaces vertical, and moving them horizontally; the support results from the motion of the wings, and ceases with it. The typical bird flight, on the other hand, is effected by placing the wing-surfaces nearly horizontal (but slightly higher in front), and moving them vertically, this propels, but does not support, and the support results from the forward motion, and lasts, even if the wings stop, till the forward motion ceases. But, on the one hand, every insect, when it moves forward, adopts to some degree the bird principle of flight; and, on the other hand, most birds occasionally support themselves, even in still air, without moving forwards, and, in this case, they place their bodies nearly vertically, and move their

wings nearly horizontally after the manner of insects. Pigeons often balance for a few seconds in this way, and almost all small birds, and the humming bird for much longer periods ; but it is, as I have shown, a wasteful action, and it would be impossible but for the power, which all animals have, of exerting for a few moments an amount of energy many times greater than that which they can continue to exert for several consecutive hours. It is known that a man can exert, for a minute at least, ten times the average energy per minute of his day's work, and it is probable that a pigeon balancing in still air is doing much the same. But the larger birds, with even smaller wing-surface in proportion to their weight, are not able to do this even for a few moments; they can support themselves only by moving forwards through the air, and when they want to remain in the same place they can only do it by flying slowly against the wind, so that the wind carries them back as fast as they fly forwards, or, if there is no wind, by flying round and round in circles. Such birds, when there is no wind, cannot rise from the ground until they have acquired some forward velocity by running, and the albatross, whose wing-surface is only half as great in proportion to its weight as the pigeon's, cannot even acquire sufficient velocity in this way, and, except in a wind, cannot rise from the ground at all.

This subject, the relation of wing-surface to powers of flight, is itself a very extensive one, and it cannot be dealt with, even in the most elementary way, without mathematics, so in this paper I have assumed, without proving, that large animals have a smaller wing surface in proportion to their weight than small animals, and that this smaller wing surface is a disadvantage from the point of view of economy of work in flight.

NOTES ON SOME ROCK SPECIMENS COLLECTED IN NORWAY BY MR. C. PUMPHREY.*

BY MR. T. H. WALLER, B.A., B.SC.

The collection of rocks which Mr. Pumphrey has put into my hands for examination and description consists of a considerable number of specimens from various localities visited by Mr. Marshall and himself between Bergen and the North Cape.

* Transactions of the Birmingham Natural History and Microscopical Society, read 16th October, 1888.

As might be expected they almost all belong to the highly metamorphic rocks which go by the names of gneiss and schist. Of these there are several varieties. On the one hand, there are specimens which in the two or three inches square which their surfaces afford are not distinguishable from granites, as they show none of the foliation which characterises the gneisses. From these there is a gradual passage to the most intensely foliated specimens which have plainly been submitted to immense shearing and rolling strains. The schists are mostly of that stage of formation in which the original constituents are not utterly lost, but only crushed, twisted, and utterly deformed, while secondary micas have formed in discontinuous layers among the fragments.

These crushed and rolled rocks have exactly the aspect of many of those from the N. W. Highlands, with the elucidation of which the name of Professor Lapworth is so closely identified. There is a pure hornblendic gneiss which almost absolutely resembles some specimens of the grey Hebridean gneiss of the Scotch district.

Of these rocks I have cut one section—from a reddish gneiss rock which yet showed by its generally rather dull aspect and the obvious knots of felspar that it had not arrived at the fully recrystallised stage of metamorphism.

Examined microscopically this structure is still more striking, and the use of polarised light shows almost every felspar grain crushed and twisted, and in by far the greater number of cases affected with the peculiar cross twinning which is characteristic of microcline, but which has been of late suspected as being specially developed where felspar crystals have been subjected to great crushing. It will be remembered that Professor Judd has proved that the ordinary twinning so frequent in plagioclase is often confined to those parts of a crystal which have been strained by being bent or crushed, and that even in quartz changes of molecular structure equivalent to twinning have been brought about by the same means.

With this specimen I should like you to compare one from the pebble beds which are so largely developed locally. At least it is really from the upper gravel beds at Catspool, near Alvechurch, but I have no doubt it is derived from the washing of the older pebble beds. It has a very similar appearance, is, however, almost altogether felspathic, and shows none of the eyes of larger felspar grains, but a very curious lineation perpendicular to the foliation (which is much more marked in the hand specimen than in the section) is apparent, giving the look of a section of wood. This seems to be due to the

twinning of the felspar grains—I imagine probably due to pressure—but there has plainly been a certain amount of cleavage and slip among the grains.

The flaggy gneissose or schistose rock from Vic, which Mr. Pumphrey informs me is used as slates in the district, would probably afford very much the same appearances modified by the fact of being made out of a more basic rock.

Another specimen from which I have cut a section is that marked labradorite from the Nerodal—I think this should be called saussurite. It contains a few very shadowy grains of some plagioclase felspar, which still retain the twinning, but the greater part is made up of a mass of mostly interlaced crystals, very ragged at the edges, but apparently formed *in situ*. Some of these seem to extinguish when their length is parallel to one of the axes of the nicols prisms, but in many the extinction angle is about 20°; there is also an indistinct cleavage in some of the larger grains, but as these seem to give brighter colours with crossed nicols, I imagine it may be another mineral which is present. In "Teall's Petrography," under the head of saussurite, it is mentioned that this substance appears to be usually a mixture of some felspar with either zoisite or epidote. Cathrein, who has very thoroughly investigated the subject, considers that no distinction can be drawn between zoisite and epidote saussurites. Dr. Reusch has described a saussurite from near Drontheim, which mainly consists of epidote either quite colourless or pale greenish yellow, and shows twinning. I think that the composition of the specimen on the table must be much like this, but I have not yet been able to refer to the original memoir. The mass has arisen by the decomposition of a highly basic lime felspar, the zoisite or epidote using up the lime. The specimen is quite different from the saussurite of the Lizard, which I show for the purposes of comparison. The latter has a much more granular structure. As Mr. Teall says:—"Indeed it must be remembered that the term saussurite has no precise signification. It is merely employed to designate the dense light-coloured aggregates which arise in connection with the alteration of a basic felspar."

One or two other of the specimens should be noticed. One huge grained quartzite and one fine glistening one are completely analogous to two from the pebble beds of Sutton.

The specimens of dolomite are particularly beautiful, both the snow white one and that which displays on part of it such a lovely rose tint.

The soap stone of Drontheim appears to be a sort of talc-mica schist with no very marked foliation. There are a

good many of the specimens which would well repay careful examination. The schist from Bergen is exactly similar to one of the Highland series from Loch Tarbert, and would be very interesting in section.

It is worth notice that tourmaline appears to be, if not absent, very inconspicuous, so that, in spite of the similarity mentioned above between these rocks and some of our pebbles, the very widespread occurrence of tourmaline in the latter seems to separate them as a whole from the Scandinavian series.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Microscopical Meeting, October 1st. The President, (Mr. W. B. Grove, M.A.) in the chair; present twenty-one members. Messrs. G. Lavender, E. F. Spicer, and F. R. Goyne were proposed for membership. Mr. W. B. Grove, M.A., exhibited (for Mr. Caswell) a fungus growth from the surface of a vat of lime-juice. It was formed by the mycelium of *Penicillium glaucum*, and was coloured a brilliant crimson on the lower surface. Mr. T. E. Bolton exhibited under the microscope living specimens of *Plumatella repens* and *Cephalosiphon limnias*. Mr. W. R. Hughes gave an account of the recent meetings at Oxford of the Midland Union of Natural History Societies; supplemented by Messrs. R. W. Chase, K. Parkes, and W. H. Wilkinson. Mr. Herbert Stone then gave his paper "On a Disputed Point in the Structure of the Stomata of Plants." He gave the result of the examination of a large number of different leaves, which tended to prove the presence of the cistoma, of which he gave an enlarged drawing, and exhibited sections of leaves under the microscope, showing the cistoma *in situ*.—Biological Section, October 8th. Mr. W. B. Grove, M.A., in the chair. Mr. C. Pumphrey exhibited *Acanthus mollis*, from King's Norton. Mr. W. B. Grove exhibited *Russula fellea*, *R. adusta*, *Hydnum niveum*, *Agaricus imbricatus*, *Ag. galericulatus* var. *calopus*, *Cortinarius rigidus* (?), *C. caninus*, *C. ochroleucus*, and *C. anomalus*, from the neighbourhood of Sutton. Mr. J. Edmonds then read his paper "On Photography as an Aid to Natural History Studies," the many beautiful illustrations of which were exhibited by means of the limelight by Mr. Pumphrey.—Geological Section, October 15th. Mr. Waller, B.A., B.Sc., in the chair. An invitation from the Geological Section of the Philosophical Society was read, and attention called to the notices issued by the Selborne Society on the protection and preservation of plants and animals. Mr. Wilkinson exhibited moths, including *Chærocampa porcellus*, *Macroglossa stellatarum*, *Zeuzera Œsculi*, and *Pterophorus pentadactylus*, from Kent. Mr. Herbert Stone showed a solution of chlorophyll in alcohol, which, on exposure to light, exhibited alternately a beautiful transparent green colour and a port wine colour. Mr. Walliker exhibited specimens of quartz covered with pyrites, from Lake Superior. Mr. W. P. Marshall read a paper on "Singular Water-worn Rocks," met with in his recent trip to the Orkneys and Shetlands.

The paper was well illustrated by diagrams. Mr. Waller made some very interesting remarks further elucidating several points touched upon by Mr. Marshall. Professor Lapworth gave a learned exposition of the peculiar symmetrical shapes, with mouldings and ridges, into which the surface of the Old Red Sandstone splits up.—SOCIOLOGICAL SECTION, October 22nd. The first meeting of this section this session. Mr. W. R. Hughes, F.L.S. (President), in the chair. There was a large attendance of more than seventy members and friends, including many ladies. An address was delivered by Miss Constance C. W. Naden, of London, on "The Principles of Sociology," of Mr. Herbert Spencer, being the fourth division of the Synthetic Philosophy. The address, which occupied more than an hour in delivery, was listened to with marked attention, and was frequently applauded. At its conclusion a cordial vote of thanks was passed to Miss Naden, accompanied by a request that she would allow it to be printed, on the motion of the President of the Society (Mr. W. B. Grove). seconded by Professor Tilden, F.R.S. Professor Lapworth, F.R.S., J. A. Langford, LL.D., and Mr. F. J. Cullis, F.G.S., also addressed the meeting. Miss Naden's address will appear in the "Midland Naturalist."

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—August 19th. Mr. Corbet exhibited a series of photographic views of the Giant's Causeway. Mr. J. Madison then read a paper, "Notes on a Holiday Ramble." The ramble commenced at Coventry, and was made for the purpose of visiting the field of Naseby, interesting from being the site of a great battle fought between the armies of Charles and Cromwell, and also the spot where the Stratford Avon rises. The places of interest passed through were Combe Park, Brinklow, Lutterworth, and Welford. Lutterworth was full of interest from its association with John Wycliff. The Avon takes its rise in a well, the stream being so small as to pass through a one-inch pipe. The return journey was made to Coventry through West Haddon, Hill Moreton, and Dunchurch. The paper was illustrated by a series of photographs taken during the ramble and shown as lantern pictures. At the close of the paper a series of photographs of the Aberystwith district, was shown by Mr. C. P. Neville.—August 26th. Mr. H. Hawkes showed an interesting collection of plants from the Chesil Bank, Weymouth; also cases or tubes of Terebella. Mr. J. W. Neville, a series of microscopical preparations of *Dytiscus marginalis*. The series comprised a number of larvæ, showing different stages of growth. Messrs. Deakin and Lilley, a large collection of Eocene fossils from Barton Clay, Hampshire.—September 2nd. Mr. H. Hawkes exhibited the following fungi :—*Fistulina hepatica* and *Spumaria alba;* Mr. Camm, *Trichia intermedia*, *T. scabra*, *T. Jackii*, and *Oligonema nitens*. Mr. Deakin, shark's teeth from Barton Cliff; Mr. Linton, a collection of fossils from Whitby. Under the microscope, Mr. J. W. Neville, mouth-organs of beetle *Ocypus olenus;* Mr. J. Moore, poison bag in jaw of spider.—September 9th. Mr. J. W. Neville showed twelve mounted slides of lepidopterous larvæ; Mr. H. Hawkes, five volumes of marine algæ, a collection made in Devonshire by Dr. William Arnold Bromfield. Under the microscope Mr. Hawkes showed the following fungi: *Erysiphe communis* and *Uncinula bicornis*.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

TWELFTH ANNUAL MEETING,

HELD AT OXFORD, SEPTEMBER 23rd and 24th, 1889.

With every augury of a most successful gathering, the delegates and members of the various scientific societies constituting the Union assembled at Oxford on Monday, September 23rd. As far as outside attendance was concerned, the Twelfth Annual Meeting was one of the very largest the Union has had. No doubt the intrinsic attractions of Oxford are great, and of these the Oxfordshire Natural History Society, the host for the occasion, availed itself to the utmost; no doubt specially strenuous efforts had been put forth, both by the host society and by the officials of the Union; but after making allowance for both of these agencies, the widespread interest in the successful maintenance of the Union, which was evinced by the attendance of sixty or more visitors, coming from centres so remote as Chester and Derby, was both satisfactory and gratifying. Amongst the visitors present at the meeting were Mr. R. W. Chase, Rev. Geo. Deane, D.Sc., Mr. W. R. Hughes, F.L.S., Mr. Geo. H. Kenrick, Mr. W. P. Ryland, Mr. and Mrs. John Rabone, Mr. and Mrs. Thos. Clarke, Mr. W. K. Parkes (Assistant Secretary of the Union), Mr. C. R. Robinson, Mr. Thos. H. Waller, B.A., B.Sc. (President of the Birmingham Naturalists' and Microscopists' Union), Mr. W. H. Wilkinson, Mr. W. B. Grove, M.A. (President of the Birmingham Natural History and Microscopical Society), Mr. Herbert Stone, Mr. F. Grimley, Mr. J. Kenward, F.S.A. (President of the Birmingham Philosophical Society), Miss Jermyn, Mr. and Mrs. Antrobus, Mr. T. V. Gardner, Dr. Lawson Tait, Professor Bridge, Professor and Mrs. Hillhouse, and others, of Birmingham; Mr. and Miss Shepheard, of Chester; Mr. Horace Pearce, F.L.S., F.G.S. (President of the Dudley and Midland Geological Society and Field Club), and Mrs. Pearce; Mr. S. D. Williams, and Mr. G. M. Stubbs, Sutton Coldfield; Mr. Francis Galton, F.R.S., of Leamington; Dr. Fitch, of Chaddesley, near Kidderminster (President of the Worcestershire Naturalists' Field Club); Rev. T. Auden, M.A. (President of the Severn Valley Naturalists' Field Club), Rev.

W. G. D. Fletcher, M.A., and Mr. Wm. Bedcall, Shrewsbury; Rev. P. M. Feilden, M.A. (President of the Oswestry and Welshpool Naturalists' Field Club); Mr. Beeby Thompson, F.G.S., Mr. W. D. Crick, Mr. A. and Mrs. Kempson, Mr. M. H. Holding, Mr. J. Shuttleworth, and Mr. T. Pressland, Northampton; Mr. R. S. Bartleet, J.P., and Dr. Wm. Smith, Redditch; Mr. E. de Hamel, Middleton Hall, near Tamworth; Mr. W. H. and M. Carl Duignan, Walsall; Mr. Isaac Knowles, Miss Bellis, Wellington; Mr. and Mrs. E. F. Cooper, and Dr. Finch, Leicester; Mr. H. A. Bemrose and Mr. G. Fletcher, Derby; while the Oxford Society provided a goodly number of attendants at the meetings, amongst whom were Mr. E. B. Poulton, F.R.S. (President, and President of the Union), Mr. H. M. J. Underhill (Secretary), and Mr. G. C. Druce, M.A. (Treasurer). Professors Westwood and Clifton, Drs. Collier, J. A. H. Murray, M.A., Sankey, and E. B. Tylor, F.R.S.; Sir John Conroy, M.A., Revs. F. J. Smith, M.A., J. W. B. Bell, M.A., J. G. Burch, B.A., Messrs. D. H. Nagel, M.A., H. Balfour, M.A., Arthur Sidgwick, M.A., W. W. Fisher, M.A., V. H. Veley, M.A., M. S. Pembrey, B.A., P. C. Mitchell, B.A., O. H. Latter, B.A., J. Woods, and many others. For the comfort of the visitors the most careful arrangements had been made. Many were most kindly and hospitably entertained at private houses, and the chief cause for regret on the part of the host society was their inability to provide similar accommodation for the whole of their visitors.

The visitors gathered in the University Museum at about two p.m., and while the members of the Council held their annual meeting, those who were not officially occupied were formed into small parties and conducted over Oxford. In the University Museum, the Pitt-Rivers Collection (Anthropology), Mr. H. Balfour, M.A., kindly explained points of special interest, and in the Hope Collection (Insects), Professor Westwood directed attention to the most interesting features, while in the Central Court of the Museum, the Collections illustrating Comparative Anatomy and Osteology, the Secondary Fossils, and the Primary Fossils in the Grindrod Collection, which are especially fine, were open to inspection. The Bodleian Library and Camera, the Ashmolean Museum (Archæology), the Clarendon Press, and the Botanical Gardens, Museum, and Library were also open to visitors.

The Annual Meeting of the Council was held at 2 30, the following being present:—Mr. E. B. Poulton, M.A., F.R.S. (President), in the chair, Mr. R. W. Chase, Rev. G. Deane, D.Sc., Rev. P. M. Feilden, M.A., Mr. W. B. Grove, M.A., Mr.

E. de Hamel (Treasurer), Prof. Hillhouse, M.A., F.L.S., Mr. W. K. Parkes (Assistant Hon. Secretary), Mr. H. Pearce, F.L.S., F.G.S., Mr. C. R. Robinson, and Mr. H. M. J. Underhill. The report of the adjudicators for the Darwin Medal, and the Annual Report were received, discussed, and adopted for presentation to the Annual Meeting, and a recommendation to the Union to appoint a committee to consider the affairs of the Union with especial reference to the privileges of the component societies and their relations with the "Midland Naturalist" was also passed.

From half-past three to half-past four afternoon tea was served in one of the galleries of the Museum, after which the

GENERAL ANNUAL MEETING

was held in the large Lecture Theatre of the Museum, under the presidency of Mr. E. B. Poulton, M.A., F.R.S., the attendance being exceptionally large. After a few words of welcome from the President, the minutes of the last meeting were taken as read, and the Secretary read the following

REPORT OF THE COUNCIL OF THE MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The Societies which are now members of the Union are as follows: —

Birmingham Microscopists' and Naturalists' Union.

Birmingham Natural History and Microscopical Society.

Birmingham Philosophical Society.

Birmingham and Midland Institute Scientific Society.

Birmingham School Natural History Society.

Caradoc Field Club.

Dudley and Midland Geological and Scientific Society and Field Club.

Leicester Literary and Philosophical Society.

Malvern Field Club.

Northamptonshire Natural History Society.

Oswestry and Welshpool Naturalists' Field Club.

Oxfordshire Natural History Society and Field Club.

Rugby School Natural History Society.

Severn Valley Naturalists' Field Club.

The Council very much regret to report that the Northamptonshire Natural History Society, under whose auspices the Annual Meeting of last year was held, have decided to withdraw, after this year, from the Union. Negotiations are, however, on foot with the Birmingham Entomologists' Society for their affiliation with the Union This is a young society which is doing very valuable work in Entomology, and the Union hope that it will raise this study to a higher level in the Midlands than it has hitherto attained.

Darwin Medal.

The subject for which the Darwin Medal is awarded this year is Geology, and the papers which have appeared in the "Midland Naturalist," and were eligible for the competition, were submitted to the following gentlemen, who had kindly consented at the request of the Council to act as adjudicators, viz., H. W. Crosskey, LL.D., F.G.S.; G. Deane, D.Sc., B.A., F.G.S.; Professor J. W. Judd, F.R.S., F.G.S.; Professor Charles Lapworth, LL.D., F.R.S., F.G.S.; J. J. H. Teale, M.A., F.G.S.; and W. W. Watts, M.A., F.G.S.

The papers submitted to these gentlemen were as follows:—

"The Middle Lias of Northamptonshire," by Beeby Thompson.

"The Geological Structure of Titterstone Clee Hill," by the Rev. J. D. La Touche.

"Niagara: its Physical and Geological Conditions," by W. P. Marshall.

"A Deep Boring near Birmingham"; "Faults in the Drift"; "Rocks of Cambrian Age at Dosthill"; "Deep Boring in Keuper Marls," by W. J. Harrison.

"Structure of Rowley Rag"; "Rock from New Zealand"; "Gold at Mount Morgan, Queensland"; "Micro-chemical Methods for Separating Minerals"; "Separation of Minerals by Heavy Solutions"; "Petrography of our Local Pebbles"; "Crystallization in Rocks"; "A Lithia-bearing Granite from South Devon"; "Notes on some Norwegian Rocks," by T. H. Waller.

"Inaccuracies in Leicestershire Geological Survey"; "Fossiliferous Hæmatite Nodules"; "Fossil Tree at Clayton"; "Stigmaria," by W. S. Gresley.

"Barium Sulphate as Cement in Sandstone," by F. Clowes.

Three of these investigations were picked out by the adjudicators for special mention, viz., those by Mr. Beeby Thompson, Mr. W. S. Gresley, and Mr. Thos. H. Waller; and of these, four of the adjudicators placed Mr. Waller first, one gave Mr. Beeby Thompson first place, and one bracketted these two gentlemen together.

Acting upon these reports, the Council have awarded the Darwin Medal for 1889 to Mr. Thos. H. Waller, B.A., B.Sc., for his researches upon Local Petrography.

Concerning these researches, Mr. Teale says, "Of Mr. Waller's work I am able to speak in the highest terms. All of it is valuable and accurate, and much of it is original." Professor Lapworth speaks of Mr. Waller's papers as "a remarkable list, . . . each of which embodies the result of a large amount of original work." Mr. Watts says, "Of the value of Mr. Waller's papers to petrologists it is impossible to say too much."

To the investigations of Mr. Beeby Thompson and Mr. W. S. Gresley the adjudicators are likewise almost unanimous in awarding high praise.

"MIDLAND NATURALIST."

The publication of the "Midland Naturalist" goes on regularly, and in the standard of the contributions there is no falling off. The principal papers are as follows:—The continuation of "The Fungi of Warwickshire," by W. B. Grove, B.A., and J. E. Bagnall, A.L.S.; the continuation of "The County Botany of Worcester," by Wm. Mathews, M.A.; the completion of "The Middle Lias of Northamptonshire," by Beeby Thompson; "Passages from Popular Lectures," by F. T. Mott, F.R.G.S.; "On the Successful Use of Oil to Calm Rough Seas," by W. P. Marshall, M.I.C.E.; "On Kew Gardens and some of the Botanical Statistics of the British Possessions," by J. G. Baker, F.R.S., F.L.S.; "The Physical Geography of the Past," by Horace T. Brown, F.G.S., F.I.C., F.C.S.; "Insularity," by Rev. H. H. Slater; "The Life History of a Myxomycete," by T. P. Blunt, M.A.; "Notes on a Tour in Norway and Collection of Plants," by W. P. Marshall, M.I.C.E., and C. Pumphrey; "The Foundations of our Belief in the Indestructibility of Matter and the Conservation of Energy," by J. H. Poynting, D.Sc., F.R.S.; "Notes on *Stigmaria*," by W. S. Gresley; "In Sherwood Forest," by Oliver P. Aplin; "Micro-chemical Examination of Minerals and the Separation of Rock Constituents by Means of Heavy Solutions," by T. H. Waller, B.A., B.Sc.; the Address of the President to the Birmingham Natural History and Microscopical Society; "Foraminifera of Oban," by E. W. Burgess; "On the Autumn Migration of Swallows and Martins," by W. Warde Fowler, M.A.; "The Work of Field Clubs," by Ch. Callaway, D.Sc., F.G.S.; "Wild Bees," by R. C. L. Perkins; "Professor Poynting on our Physical Beliefs," by Herbert Stone, F.L.S.; Book Reviews, by W. B. Grove, B.A., W. R. Hughes, F.L.S., and others; and a sympathetic Memoir, by W. R. Hughes, F.L.S., of his friend, the late Philip Henry Gosse, F.R.S.

The Council are glad to observe that this list includes the names of several members of the more outlying societies of the Union. They cannot but think that "The Midland Naturalist," as the official organ of the Union, might be much more widely made use of for the purpose of recording the transactions of the various societies in the Union than it has hitherto been. However laudable may be the desire on the part of larger societies in the Union to publish their own proceedings, they feel that this separate publication necessarily deprives the general scientific public of any cognisance of their work. From this point of view it would be far better that the Union should have one strong organ than that the various societies constituting it should each publish a separate journal of the work of its members.

There have been a number of papers of importance read before the societies in the Union who publish their own separate proceedings. The

Birmingham Philosophical Society's last published volume contains papers on "The Constitution of a Popular University," by Dr. W. A. Tilden, F.R.S.; on "The Extensor Tendons of the Manus of Apes," and "Congenital Malformations," by Dr. Bertram C. A. Windle, M.A.; on "The Collection and Use of Local Statistics," by Mr. J. Thackray Bunce, F.S.S.; "Suggestions for a Midland University," by the Rev. H. W. Watson, D.Sc., F.R.S.; on "The Distribution of Boulders in South Shropshire and South Staffordshire," by Mr. F. W. Martin, F.G.S.; on "The Cranial Anatomy of Polypterus," by Professor T. W. Bridge, M.A.; and by the same author a paper on "The Air-bladder in certain Siluroid Fishes;" on "The Suppression and Specialisation of Teeth," by Mr. J. Humphreys, L.D.S.I., and by Professor Poynting, D.Sc., "On a Form of Solenoid Galvanometer"; by Dr. H. W. Crosskey, F.G.S., on "The Glacial Geology of the Midlands."

The Northamptonshire Natural History Society and Field Club continue their interesting quarterly journal. Lord Lilford continues his "Notes on the Birds of Northamptonshire;" Mr. G. C. Druce, F.L.S., is still at work at the "County Flora;" Mr. Beeby Thompson, F.C.S., F.G.S., extends his exhaustive analysis of "The Upper Lias of Northamptonshire;" the Rev. H. H. Slater's address on "Insularity," is printed in No. 35 of the journal. Mr. Walter D. Crick contributes an article on "*Helix Pomatia* in Northamptonshire," to No. 36, which also contains some meteorological reports and observations.

The Transactions of the Leicester Literary and Philosophical Society are as interesting as they are varied. Mr. F. T. Mott, F.R.G.S., contributes papers on "The Native Trees of Leicestershire;" "The Ferns of Leicestershire," and "On Cultivation." Mr. W. A. Vice, M.B., has a contribution on "The Teeth in the Order Rodenta." An article by Mr. Montagu Browne, F.Z.S., on "The Antiquity of Man in Leicestershire," is accompanied by a number of excellent illustrations. Part X. contains contributions by Mr. T. Carter, L.L.B., on "The Parasitic Phanerogams of Leicestershire"; and by Mr. G. H. Storer on "The Habits and Voices of British Song Birds." In Part XI. Mr. H. G. Quilter discourses on "The Rhaetics of Leicestershire," and the Rev. T. A. Preston, M.A., on "Fruits." Mr. J. W. Knowles contributes a paper on "The Theories as to the Variations of Race in Mankind," and Mr. F. R. Rowley on "Facts concerning *Hypopus*." Literary papers on "Sartor Resartus," by Mr. J. D. Paul, F.G.S., and by Mr. A. H. Paget, on "The Beaumonts of Gracedieu," help to make the transactions of great interest.

During the year the General Honorary Secretary of the Union, Mr. Thos. H. Waller, B.A., B.Sc., has decided to resign his office, and the Council takes this opportunity of tendering to him their hearty thanks for the time and thought which he has given to the Union during the five years he has held that responsible post.

As to the general condition of the Midland Union, the Council cannot but feel that there is much to be desired. The Union has in the past done a large amount of most valuable work, and so far from believing that the days of its chief utility are over, the Council consider that, if its work is rightly directed, it can do much more in the future than it has done in the past.

In conclusion, the Council desire once more to draw the attention of the constituent societies to the growing custom of the separate publication of their proceedings. While they do not feel justified in

laying down any hard and fast rule, they cannot but believe that in most cases this separate publication is a serious error. They have already referred to this from the point of view of the general scientific public, but from that of the societies themselves they believe that the disadvantage is even greater. The burden upon the finances of the societies which publish is unduly great, much is published which does not justify its cost, and the range of distribution of that which is published is unduly restricted, while the interest of the meetings of the society is to a large degree discounted.

These matters the Council would commend to the most serious consideration of the members of the Union, and in the assured conviction that while it is no doubt true that to some extent a society exists for its members alone, it is equally true that for a society to not only preserve its vitality, but also preserve its youth and freshness, the range of its operations must be as broad as it can practically be made.

In completion of the Report of the Adjudicators and decisions of the Council and Annual Meeting, the President then presented the Darwin Medal for 1889 to Mr. Thos. H. Waller, B.A., B.Sc., in recognition of the value of his researches on Local Petrography, &c. After a few words of acknowledgment from Mr. Waller, the meeting approved the

TREASURER'S REPORT.

Dr. RECEIPTS.

		No. of Mbrs.	Rate.	£	s.	d.
1888. July 4th.	To Balance in hand			21	1	11
1889.	Rugby School Natural History Society	258	1	1	1	6
	Oswestry and Welshpool Naturalist Field Club ...	40	3	0	10	0
	Birmingham Natural History and Microscopical Society...	147	3	1	16	9
	Caradoc Field Club	60	3	0	15	0
	Oxfordshire Natural History Society and Field Club	73	3	0	18	3
	Northamptonshire Natural History Society... ...	150	3	1	17	6
	Leicester Literary and Philosophical Society ...	271	3	3	7	9
	Birmingham School Natural History Society ...	12	1	0	1	0
	Birmingham and Midland Institute Scientific Society...	184	1	0	15	4
	Birmingham Microscopists' and Naturalists' Society	30	3	0	7	6
	Dudley and Midland Geological and Scientific Society and Field Club	80	3	1	0	0
	Malvern Field Club	50	3	0	12	6
	Birmingham Philosophical Society	120	3	1	10	0
		1,475		£35	15	0

Cr. PAYMENTS.

		£	s.	d.
1888.	T. H. Waller, Secretary's Expenses	2	7	6
	J. Moore, Gold Medal	7	16	6
	,, Bronze	0	2	10
	Wright, Dain, Peyton and Co.	0	17	6
1889.	Wright, Dain, Peyton and Co....	2	8	11
	Treasurer, Postages, &c....	0	3	0
	Balance in hand	21	18	9
		£35	15	0

The Election of Officers then took place, Mr. E. de Hamel being re-elected Treasurer, and Dr. Lawson Tait and Mr. Kineton Parkes, Secretaries. A vote of thanks to the Officers of the past year was then passed, especial reference being made to the retirement of Mr. Waller from the post of secretary, which he had held for five years. A Committee, as follows, with power to add to their number, was appointed to enquire into the affairs of the Union, and its relations with the Midland Naturalist :—Mr. R. W. Chase, Dr. G. Deane, Mr. G. C. Druce, M.A., Mr. R. M. Dixon, Rev. P. M. Feilden, Mr. E. de Hamel, Professor Hillhouse, Mr. H. Pearce, Mr. E. B. Poulton, F.R.S., Dr. Lawson Tait, and Mr. Beeby Thompson.

The President then delivered the Address on "Heredity." printed at pages 245-58.

Mr. Francis Galton, F.R.S., spoke at considerable length upon the question, and referred to many of his own investigations, which had led him independently to the same conclusion as that adopted by Professor Weismann.

Dr. Collier stated that he should not have ventured to take part in the discussion had he not felt that some of the opinions advanced by Professor Weismann were opposed to the views held by the bulk of the medical profession. Mr. Poulton had told them that if Weismann's Theory of Heredity were true, it would not allow that acquired characters could be transmitted ; but Dr. Collier asserted that the general opinion of the medical profession was that certain morbid changes in the tissues and organs of the body acquired during adult life might in some subtile manner be transmitted to the offspring, and render the offspring far more likely to develop the disease from which the father and mother suffered than would be the offspring of healthy individuals. He would take, as an example, gout. Let us suppose that a healthy man marries at thirty, leads a healthy life, and has two or three children. Between thirty-five and forty he then begins to indulge himself with the pleasures of the table, eats large quantities of animal food, drinks largely of the heavier wines, and at the same time takes very little exercise. As a result of this he develops a distinct attack of gout. Now experience proved that the children that might be born to such a man after he had developed gout would be far more likely to suffer from gout than were the children he had had previous to the development of the disease. Experience had

also shown that the children of gouty parents developed the disease generally some years earlier than their parents. For example, the father would have it at forty or fifty, the children at twenty to twenty-five. Further, the younger children were more liable to suffer than the elder. Now what was gout? It was known that the symptoms were due to an excess of uric acid in the blood. It was believed by many that this excess was due to some injury inflicted on the liver by over feeding and over drinking, which prevented it properly fulfilling one of its functions. that was the conversion of the nitrogenous portions of the food into soluble urea. Now most medical men would hold that this injury inflicted on the liver might in some subtile way be transmitted to the offspring, so that their livers bore as it were the imprint of their father's disease, and were therefore, when the slightest strain was thrown upon them, more likely to break down than were the healthy livers of other children. Again, take the case of consumption. It was known that something like thirty-five to forty per cent. of the children of one consumptive parent developed consumption, but when both parents suffered from it nearly a hundred per cent. developed and died of this disease. It was now known that consumption was due to the growth and development of a vegetable organism in the lungs. And medical men believed that the growth and development of this organism in the lung produced some change in it, the imprint of which change could be transmitted to the lung of the offspring, rendering the lung much more liable to be attacked by the organism than an ordinary healthy lung. Another example he might give was that of hæmophilia, a disease characterised by immoderate bleedings; so that patients suffering from this disease would bleed spontaneously, or the slightest cut or the removal of a tooth would be followed by bleeding so severe and so difficult to arrest as to endanger life. Now it was held that this tendency was due to some subtile change in the walls of the blood-vessels which rendered them much weaker than the walls of healthy vessels, but the way in which the disease was transmitted was exceedingly interesting. The disease descends to the boys through the mothers, the women remaining quite healthy. Thus, one boy of a family of six acquires the disease, he marries, his sons and daughters are apparently healthy and do not suffer, but the disease again appears among the male children of his daughters, and so on from generation to generation. One other point he would like to mention, and

that was his surprise that Professor Weismann had apparently paid so little attention to the difficulties which the transmission of hereditary diseases would seem to offer to this theory of heredity, while he had devoted a whole lecture to disprove the supposed transmission of mutilations. For he, Dr. Collier, felt sure that hardly a medical man could be found, and very few of the general public, who ever thought that the effect of mutilations, such as scars, or removal by accident (or otherwise) of portions of the body, were in any way transmitted to the offspring.

Professor Hillhouse proposed a vote of thanks to Mr. Poulton for his address. After referring to the fact that besides those of Darwin and Weismann, there existed two other important theories of heredity, those of Nägeli and of Strasburger, he pointed out cases existent in the vegetable kingdom which were not readily explicable by the Weismann theory, which theory he looked upon as in large degree unnecessary. The resolution was seconded by Dr. Lawson Tait, who supported the view of Dr. Collier as to the transmission of acquired characteristics, and further enforced the case of hereditary bleeding as one in point; and a lively passage of arms arose between Dr. Tait and Mr. Francis Galton, owing to the trenchant criticism by the former of the use of the word "heredity."

The vote having been carried, the proceedings closed with a hearty vote of thanks to Mr. H. M. J. Underhill, Secretary of the Oxfordshire Natural History Society, for the admirable arrangements he had made for the meeting of the Union.

CONVERSAZIONE.

By the kind permission of the University Delegates the Conversazione in the evening was held in the University (Ashmolean) Museum. About 700 guests were present, and they were received by the President, Mr. Poulton, and Mr. Underhill, the Secretary of the host society. In addition to the remarkable collection of varied and interesting objects with which the great Museum and the Pitt-Rivers Museum are filled, a programme for the amusement and instruction of the visitors was provided, the wealth of which our space only enables us in the briefest way to depict. In the Large Lecture Theatre in the North Gallery, Dr. E. B. Tylor, F.R.S.,

gave to an overflowing audience a series of demonstrations illustrating savage methods of procuring fire, and Mr. Henry Balfour, M.A., discoursed on bows and arrows, and described a series of specimens illustrating the Lapland Whale Fishery. The Radcliffe Library (West Gallery) was open during the evening, by kind permission of the Librarian, Sir Henry Acland, K.C.B., D.M., F.R.S. ; as also was the Court of the Clarendon Laboratory, by kind permission of Professor R. B. Clifton, F.R.S., where he, assisted by Mr. Walter R. Clifton, exhibited acoustical apparatus in the Lecture Room of the Laboratory. The Hope Collection of Insects (South Gallery), unrivalled in certain departments, was, by kind permission of Professor J. O. Westwood, M.A., exhibited and explained by himself, the Rev. J. W. B. Bell, M.A., and Mr. Arthur Sidgwick, M.A. In the Central Court of the Museum, the Rev. F. J. Smith, M.A., showed some recent forms of apparatus employed in physical research ; by kind permission of Professor W. H. Jackson, M.A., Mr. O. H. Latter, B.A., exhibited microscopical preparations and living specimens of various animals, and Mr. P. C. Mitchell, B.A., showed the working of microtomes and the methods employed in the preparation of microscopical sections. Mr. G. C. Druce, M.A., displayed a collection of the grasses of Oxfordshire, and Mr. J. B. Farmer, B.A., described and illustrated a method by which Algae, &c., may be grown upon a microscopic slide, and also showed some botanical specimens. The anthropometric apparatus of Mr. Francis Galton, F.R.S., was also exhibited ; while in a side room the Rev. J. G. Burch, M.A., showed his interesting perspective microscope. In the South Corridor, Mr. W. W. Fisher, M.A., showed some brilliant fusion experiments with oxygen, and Mr. V. H. Veley, M.A., also showed chemical experiments. In the Geological Lecture Room in the South Corridor, Mr. M. S. Pembrey, B.A., performed some physiological experiments. In the Lecture Rooms in the South Gallery, Sir John Conroy, M.A., showed some experiments on fluorescence, and Mr. D. H. Nagel, M.A., experiments with sensitive flames. In the Large Lecture Theatre (North Gallery), Mr. H. M. J. Underhill exhibited, with the oxy-hydrogen lantern, coloured slides of his own preparation representing the microscopic organisms from the ponds and rivers near Oxford, and others illustrating a Japanese legend of some evolutionary interest, the beauty of the slides being much appreciated. The Conversazione did not close till nearly midnight.

Tuesday.

Arrangements had been made on this day for an excursion to Shotover Hill, where Mr. Poulton had proposed to deliver a discourse upon the geology of the district. From an early hour, however, it was seen that the weather would make any attempt of this kind a disastrous failure, and, much to the regret alike of hosts and guests, it had to be abandoned. With ready courtesy, however, the Ashmolean Museum was opened, and Mr. Balfour, who had undertaken to give up his afternoon to the guests, most courteously sacrificed his morning also. To this museum most of the visitors made their way, and examined, at greater leisure than had been possible on the previous evening, its invaluable contents, while Mr. Balfour explained the most interesting items in the Pitt-Rivers Anthropological Collection, and Professor Westwood talked over his favourite butterflies and moths.

At about one o'clock a company, numbering between eighty and ninety guests, sat down to luncheon in the Hall of Christ Church, where an excellent collation was provided. The President (Mr. E. B. Poulton), occupied the chair, while the vice-chairs were filled by Mr. G. C. Druce, M.A., Mr. H. M. J. Underhill, and Professor Hillhouse (Birmingham). At the close of the luncheon,

Professor Hillhouse rose and said he believed that that would be the last occasion upon which they would all meet together, and, therefore, it would be the last opportunity they would have of offering to their hosts the tribute of their thanks—(applause). As to the merits of their hosts, he hardly thought that any words of his could possibly paint them in fitting aspect. They had seen them as business people ; they had had them as their guides in their various pleasant occupations during the preceding twenty-four hours, and many had appreciated their hospitality in more private capacity. He ventured to say that in no previous meeting of that Union—certainly no meeting for the last eight or ten years—had the duties of hosts been attended to with so much assiduity or with so much success as on the present occasion. He asked those present, as representatives of the Midland Union of Natural History Societies, to accord to the Oxford Society a most hearty vote of thanks for their kindness and courtesy, and

the incessant attention which they had shown the visitors during the meeting—(applause)—and to couple with the toast the names of Mr. Poulton and Mr. Underhill.

Mr. W. R. Hughes, F.L.S. (Birmingham), seconded the vote, which was most cordially received.

Mr. Poulton returned hearty thanks on behalf of the Oxford Society for the kind way in which the visitors had spoken of them, and said it had been a very great pleasure to the Society to see those from a distance among them. He felt that the Union had a very great work to do, and thought that Natural History Societies made a great mistake in very often thinking that they could do better work themselves than by joining a Union like theirs. He deprecated the use of so many organs in which the doings of Natural History Societies were made known, and said that a few good magazines should contain the work of all the Natural History Societies of the country. He thought it was an advantage for Societies to combine, and that their Union did an admirable piece of work in leading such a combination. In conclusion, he wished to express in the name, he was sure, of all present their most sincere and hearty thanks to the Dean of Christ Church for lending them the use of the Hall on that occasion —(applause). He (the speaker) thought it was most appropriate that their Society should meet and have lunch in the first Hall in Oxford, and when the Dean of Christ Church was approached on the subject he very kindly consented at once to their having the use of the Hall—(applause).

Mr. H. M. J. Underhill also returned thanks, and seconded the motion, which was unanimously agreed to, and the proceedings closed.

In spite of the ceaseless drizzle, parties were now made up under local guidance to visit some of the lions of Oxford. Thus a number, under the guidance of Mr. Poulton, proceeded to the Hall and Chapel of Magdalen College, and thence to the Botanical Gardens on the opposite side of the road, where Mr. Farmer, assistant to Professor Vines, was present throughout the afternoon. Some again visited the Pitt-Rivers Collection, where Mr. Balfour again explained the most interesting features; others the Hope Collection of Insects, under the guidance of the Rev. J. W. B. Bell. The Bodleian Library was open from two to four p.m., the Bodley

Librarian, Mr. E. W. B. Nicholson, M.A., kindly giving a short history of the Library, and the Camera was also open throughout the afternoon. The Clarendon Press was visited by a party, and the processes of electrotyping were illustrated. The Radcliffe Observer, Mr. E. J. Stone, M.A., F.R.S., kindly consented to show the instruments, &c., at the Radcliffe Observatory, to one party at three p.m., and another at four p.m. The Radcliffe Observer and Mrs. Stone very kindly invited both parties to tea at four p.m. A small party visited Dr. J. A. H. Murray's Scriptorium, in which the great dictionary is being prepared. To some extent these afternoon parties were interfered with by the weather, but the aggregate attendance at them was larger than might have been expected, and no doubt satisfied the various hosts that the courtesy they were showing to their visitors by no means fell upon thankless soil.

We cannot conclude this brief report without congratulating the Union upon a most brilliant and successful meeting, and giving hearty expression to the indebtedness of the members, in the first instance, to Mr. Poulton, President, and Mr. H. M. J. Underhill, Secretary, of the Oxford Society, to whose constant and thoughtful care so much of the success was due ; and after them to the various members of the Reception Committee, and to those who, in more private way, added by their hospitality to the comfort and pleasure of the visiting members.

Review.

A Contribution to the Flora of Derbyshire. By the Rev. W. H. Painter. 8vo, pp. 156. Map. London: G. Bell and Sons. Price 7s. 6d.

The preface of this new Flora is short, and gives little explanation of the work itself or the reasons which induced the author to publish it in its present form. The introduction contains only a meagre reference to the geology of the district and a sparse description of the topographical divisions and of the river systems of Derbyshire. In the recent Flora of South-West Yorkshire, by Mr. F. Arnold Lees, these portions have been so completely treated as to render it difficult indeed to follow him, while it raises the standard by which we must judge such books. Surely the geology of Derbyshire and its influence on plant distribution can scarcely be dismissed in thirty-two lines! The various classes of citizenship of plants are then enumerated, the author using them in the same sense as in Watson's Cybele.

They are given as follows in the Flora, and compared with the British list :—

	Britain.	Derbyshire.
British	532	532
English	409	282
Germanic	127	14
Highland	120	9
Scottish	81	30
Atlantic	70 .. .	3
Intermediate	37	16
Local	49	3
	1,425	889

Here there must be some error, as it is not probable that Derbyshire contains all the British types. It is likely that 800 would more correctly represent the total number of Derbyshire plants apart from aliens.

The zones of temperature and altitude are given verbatim from Baker's Lake District Flora. No notice is taken of the meteorology of the county.

The bibliography of Derbyshire is appended, but it is by no means exhaustive. No reference is made of Parkinson, although a Derbyshire station is recorded in the *Theatrum*, nor of the Phytologia Britannica, notwithstanding Wm. How there includes "*Ononis* var. *albo* neere Derby," and of "*Jacea sive Herba Trinitatis elegantis flore luteo amplissimo* neere Edenhole in the Peeke, and about Buckstone," nor of Merrett's Pinax, in which the two latter records are quoted. The list of recent workers appears more complete, and contains valued names, such as Bloxam, Churchill, Babington, J. G. Baker, W. H. Purchas, W. R. Linton, &c.

The list of Derbyshire plants then follows, the nomenclature employed being that used by Mr. J. G. Baker in the Lake District Flora, but it would have been preferable to follow, at any rate, the sequence of the London Catalogue, based as that is on Bentham's and Hooker's Genera Plantarum. Our nomenclature, it is true, is at present by no means fixed, and pending the issue of some authoritative work the adoption in its entirety of the names used in the London Catalogue is a matter for consideration. At any rate, important works such as the Floras of South-West Yorkshire, Hereford, and Suffolk have kept on the old lines, which, incorrect as they doubtless are in many cases, have at least the doubtful merit of custom to account for their retention. There can be no use, however, in the perpetuation of such errors as *Galium cruciatum*, Linn., *Trifolium ochroleucum*, L., *Bryonia dioica*, Linn., *Alnus glutinosa*, L., *Rumex Hydrolapathum*, Huds., &c. These should read *Galium Cruciata*, Scop., *Alnus glutinosa*, Gaertn., *Bryonia dioica*, Jacq., *Trifolium ochroleucon*, Huds., *Rumex Hydrolapatheum*. Huds.

There are also certain rules for citation which it is desirable to follow. (The writer may take this opportunity of pleading for forgiveness for his own sins of omission and commission.) For instance, a capital must be used for any specific name which pre-Linnæan writers had used as an appellative or in a generic sense. For instance, we should write *Scabiosa Succisa*, L., *Anthyllis Vulneraria*, L., *Lysimachia Nummularia*, L., *Andromeda Polifolia*, L.

The use of varietal names again is by no means correct. Very many plants described as species have their author's name attached, as though they had called them varieties, *e.g.*, under Rosa, *var. subgloba*, Sm., *var. glauca*, Vill., &c., were originally described as species, and called *Rosa subglobosa*, Sm., *Rosa glauca*, Vill. It is more correct, therefore, to write *var. subglobosa* (Sm.) or *var. R. subglobosa*, Sm. The more correct way being to use the first varietal name by which it was called and its author; thus—var. *subglobosa*, Baker.

Here, too, we must express our regret that so little attention has been paid to the critical forms or even well marked varieties, nor is the distribution of the species at all thoroughly worked out. For instance, under *Chara vulgaris* two localities are given. Is it such an extremely rare plant in Derby?

Many of Mr. Purchas's notes are extremely interesting. So, too, are the remarks upon *Salix undulata*, by Dr. Buchanan White. Ehrhart, not Ehrhardt, and Döll, not Döle, are the correct names for the two botanists mentioned in it; and, later on, Hackel is mispelled Haeckel. It is the botanist, not the philosopher, who described the *Festuca* variety *capillata*, which had, however, a previous name, Gaudin having called it *var. paludosa* in the Flora Helvetica.

Under *Salix fragilis*, L., a variety *britannica* is given, but no reference is made to Dr. Buchanan White, nor is any synonym of the species itself given, so we are left uncertain as to whether the record refers to *S. viridis*, Fries, or to *S. Russelliana*, Sm.

Under *Melampyrum pratense* L., *var. ericetorum*, D. Oliver, is given. Has this been seen by Mr. Painter or any competent botanist?

"Topographical Botany" is frequently the only authority given for the occurrence of a species in the county. This is not very satisfactory. It would have been by no means difficult to have obtained Mr. Watson's authority for their insertion in that work. Take, for instance, "*Cephalanthera grandiflora*, Bab." (or, as it should be called, *C. pallens*, Richard, = *C. grandiflora*, S. F. Gray), Mr. Painter gives "Top. Bot. No authority." In the list of books quoted as used for the purpose of compiling the Flora, Mr. Painter includes the New Botanists' Guide, by Mr. Watson, and the Botanists' Guide, by Turner and Dillwyn. The plants in the latter book, Mr. Painter states, were taken from Pilkington's Account of Derbyshire. On referring to

Watson's Guide, we find *Epipactis grandiflora* [*Cephalanthera grandiflora*] recorded for Newton Wood, on the authority of B. G., which, teste Mr. Painter, was derived from Pilkington. So, too, with *Gentiana Pneumonanthe*, where Egginton Heath is given on the same authority; and so, too, with *Chlora perfoliata*, Pleasy Park and Whitewell being given as localities. Under *Mentha Pulegium*, we are told it is queried in Top. Bot., whereas in the Bot. Guide it is recorded from Pinxton, Ockbrooke, Radbourne, and Langley Commons.

Even under such a typical Derbyshire plant as *Polemonium*, some of the records in the New Botanists' Guide do not appear to be given. Such are Lover's Leap, near Buxton; rocks in the Winnets, near Castleton; Alfreton Brook, Bakewell Meadow. These are rather serious omissions, as the chance of verifying the doubtful records (if they are such) is to give in what is described as a County Flora all the available information respecting them.

These remarks must not prejudice the reader against the book. Such is not by any means the intention of the writer, for, so far as it goes, the Flora is a correct summary of the more recently published records of Derbyshire plants, placed before us in a compact, well-printed form. We only regret that having spent, as Mr. Painter must have done, so much labour (how much only those who have attempted a similar work can rightly appreciate) upon the book, he had not delayed its publication a little longer, so as to have made it more thoroughly representative of the interesting county it deals with. This, we hope, he will yet find time to do. Till then British botanists must thank him for temporarily filling up the gap in our list of County Floras.

The few following records of Derbyshire plants are taken from MSS. in a copy of the Dillenian Ray, in Library of Oxford Botanical Garden :—

Draba muralis, Castleton, Matlock, Mr. Yalden.
Cochlearia anglica, Hill, near Castleton, Mr. Yalden.
Thlaspi alpestre, Matlock, Mr. [Sir Jos.] Banks.
Cardamine impatiens, Matlock, Mr. Banks and Sir. Jno. Cullum; Middleton Dale, Duchess of Portland.
C. bellidifolia, near the edge of Derbyshire, Mr. Bolton.
Polemonium cœruleum, near Castleton, Mr. Banks; Alfreton Brook, Dr. Oaks.

G. C. Druce.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Annual Conversazione was held at the Mason College, on Tuesday, October 29th; 174 members and friends were present. A

unique and beautiful collection was exhibited of coloured drawings of British shells, "Gibsone's Conches," made by the late George Gibsone, of Newcastle, and shown by his grandson, Rev. B. W. Gibsone, of Hinckley, who kindly came over for the purpose. Mr. E. Catchpool, of Sheffield, showed, in action, a series of very interesting and ingenious models of his own design and construction, illustrating the mode of flight of birds and insects; also specimens of ants' nests, showing the ants at work, which he had kindly brought from Sheffield for the Conversazione. Councillor Clayton contributed a fine series of photographs of Ceylon, India, Japan, Algeria, and the Yosemité Valley, which he had brought home in his recent travels; and a complete model of a Japanese house. Mr. F. Shrive exhibited twenty-four cases of British Lepidoptera, collected in the neighbourhood by himself. Mr. W. H. Wilkinson exhibited a number of cases of butterflies and moths, collected by himself in England and Scotland. Mr. W. R. Hughes exhibited a very unique and beautiful specimen of red coral, *Corallium rubrum*, showing the polypes expanded, which had been obtained from 1,000 feet depth in the Mediterranean, near Naples; also specimens of *Amphioxus lanceolatus* and an Ascidian. Mr. R. W. Chase exhibited a series of specimens of British Corvidæ; also a new British bird, *Emberiza cioïdes* (Brandt's Siberian Bunting), obtained at Flamborough Head, November, 1886, which is the only known European specimen, the bird being a native of Siberia. Mr. C. Pumphrey exhibited a living specimen of a young gull, and an adult bird that had been lent by Mr. Chase for the purpose. Dr. Sankey, of Oxford, contributed specimens of the curious nest of the Trap-door Spider, from Italy (the Riviera). Professor Bridge exhibited a collection of British shells, recently presented to the College, that were arranged in very complete series from youngest to oldest of each kind. Mr. E. F. Spicer exhibited a fine group of badgers, and specimens of birds. Mr. J. B. Stone exhibited a portion of an extensive and valuable collection of dried plants that he had obtained in different parts of Europe. Mr. J. H. Jaques exhibited an interesting series of Nórway photographs on glass lantern-slides, taken in a recent visit by himself; and a number of photograph lantern-slides were exhibited by Mr. C. Pumphrey, Mr. C. J. Watson, Mr. J. Edmonds, and Mr. C. Mantell, including many beautiful photographs of flowers. A large collection of microscopes was exhibited by members of the Society, showing various Natural History objects. The President, Mr. W. B. Grove, M.A., exhibited a collection of fungi from the neighbourhood, and contributed to the refreshments a large dish of cooked Oyster Mushroom (*Agaricus ostreatus*), served with a gravy from *Coprinus comatus* and other selected fungi, which was partaken of by the company. The room was decorated with plants kindly lent by Mr. Spinks, of Messrs. Hewitt's Nursery, Solihull.—Biological Section, November 12th; Mr. Charles Pumphrey in the chair. Mr. Thos. E. Bolton exhibited and described *Amphioxus lanceolatus*, the Lancelet, the lowest form of vertebrate animals. This curious fish is devoid of skull and bones, the vertebral column being represented by an unjointed rod of cartilage extending the full length of the body.—Microscopical Section, November 5th; Mr. W. P. Marshall, M.I.C.E., in the chair. Mr. J. E. Bagnall, A.L.S., exhibited a very rare fungus, *Cantharellus radicosus*, grown on charcoal, from Crowell, Oxon. Mr. W. H. Wilkinson then read a paper on "Growing Cells for Use with the Microscope." He exhibited the glass cells and apparatus used for the constant supply of water and air to enable the student to watch the development of minute organisms through all their stages, without

the necessity of ever disturbing or retarding the objects under observation during the whole time of their culture. His remarks were further illustrated by diagrams. A discussion was afterwards held in which Messrs. J. E. Bagnall, J. Edmonds, G. M. Iliff, and others took part.—SOCIOLOGICAL SECTION, November 14th. Mr. F. J. Cullis gave an able exposition of the first three chapters of Mr. Herbert Spencer's "Principles of Sociology" to a large and appreciative audience, which was followed by an interesting discussion in which many of those present took part.—GEOLOGICAL SECTION, November 19th; Mr. T. H. Waller, B.A. B.Sc., in the chair. There was a very large attendance, 250 being present, to hear a paper by Messrs. R. W. Chase and Pumphrey on "A Trip to the Norfolk Broads." The paper was largely illustrated by photographs of especial interest, taken by Mr. C. Pumphrey during the excursion. The views included many cathedrals, and other buildings archæologically interesting, various birds' nests, with their natural surroundings, scenes on the Broads, and two very special views of a decoy for wild duck, taken at Fritton, together with a photograph of Mr. Thomas Page, the keeper. The lecture was given in the Examination Hall, Mason College. At the close a vote of thanks to the two gentlemen above-named was carried with acclamation.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 16th. Mr. Deakin exhibited a collection of land shells from Cape Finisterre, and pointed out the very small differences between them and English types; Mr. J. W. Neville, Lady's-mantle Rust *(Uromyces intrusa)*: Mr. J. Madison, specimens of *Limnæa auricularia* var. *reflexa*, from King's Norton. Under the microscope Mr. J. Moore showed palate of *Cochlicopa tridens;* Mr. H. Hawkes, *Aphis populi.*—September 23rd. Mr. H. Hawkes showed under the microscope preparations of *Erica tetralix* and *E. vulgaris*, showing pollen, glandular hairs, and pouch-like anthers; Mr. J. Collins *Chætophora endiviæfolia*, a freshwater alga, from Sutton Park; Mr. Parker, cyclosis in *Nitella translucens.*—September 30th. Mr. Deakin exhibited specimens of *Typhis pungens* and other shells from the Eocene formation of Barton Cliff; Mr. J. Madison, a short spired variety of *Limnæa stagnalis*, from Milford. Under the microscope Mr. H. Hawkes showed a rare seaweed, *Naccaria Wigghii*, and a section through a flower-bud of horse chestnut.—October 7th. Mr. J. W. Neville exhibited specimens of "coal balls," and sections of the same material showing fossil plant structure, notably transverse sections of fern stems; Mr. J. Madison, wing of fossil insect from rhætic bed, Knowle; Mr. Lassita, a series of Silurian fossils from Aldridge; Mr. T. H. Waller, specimen of band of diorite, showing the line of contact with the Stockingford shale, from Nuneaton; Mr. J. Moore, a section of coral, *Cyathophyllum reticulatum;* Mr. H. Hawkes, tail of rattlesnake; also the following fungi: *Nectria cinnabarina*, *Peziza cyathoidea*, and a mould on *Trichia varia*. Mr. Camm, *Alwisia intermedia* and *Hemiarcyria* sp.—October 14th. Mr. H. Hawkes showed fasciated stem of asparagus. Mr. J. W. Neville then read a paper, "Notes on the Ovipositors of Insects." The writer said it might be thought an ovipositor need only be a very simple contrivance, a tube (perhaps telescopic, to enable it to be withdrawn into the insect's body when not in use) through which the eggs might pass from the ovary to their destination. This was all we found in some insects, but in others the ovipositor and its contingent organs grew very complicated. The

various orders of insects were then reviewed at some length, the peculiarities of each being described. Of all orders the Hymenoptera gave the most numerous instances of specialised forms. The paper was illustrated by a series of drawings.—October 21st. Mr. J. W. Lassetter exhibited a series of specimens of *Atrypa reticularis*, showing various stages of growth. Mr. H. Hawkes, mounted specimens of our rarer plants, including *Sibthorpia europæa*, *Neottia æstivalis*, *Silene acaulis*, *Dianthus cæsius*, *Lobelia urens*, &c., and, under the microscope, stellate hairs on corolla of *Corea preciosa*.—October 28th. Mr. Camm exhibited, under the microscope, the following fungi: *Hemiarcyria rubiformis*, *H. Serpula*, and *Craterium aureum*, the two last from Carlisle. Mr. Thompson then read a paper, "Notes on the Crayfish." The writer, in describing the life history of this crustacean, said that though they were little esteemed by us as an article of food, yet on the Continent they were in great request, the demand for them in France exceeding the supply. After speaking of their habits in summer and winter and the different methods employed in taking them, the writer dealt at some length on the normal and abnormal development of their swimmerets, mouth organs, antennæ, antennules (containing organs of hearing), gills, bronchial chamber, heart, stomach and gastroliths within it. The paper concluded with an account of their method of reproduction. The subject was illustrated by a series of drawings and dissections.—November 4th. Annual Meeting for election of officers, &c. The General Secretary, Secretary of Committee, Curator, and Treasurer presented their reports, the latter stating that there was a balance of £3 17s. 5d. in favour of the Society. On the motion of Mr. White, the reports were adopted. Mr. T. H. Waller, B.A , B.Sc., the retiring President, proposed Professor Hillhouse, M.A., F.L.S., as President for the ensuing year. Messrs. C. P. Neville and J. Edmonds seconded and supported the nomination, which was carried unanimously. The President said it gave him great pleasure to accept the post. Although he could not hope to attend all the meetings of the Society, still he trusted to be able to take a useful part in it. The Society was performing an unassuming work, which it was a pleasure to read of from month to month, and he would do what he could to help forward and further its best interests. The following officers were then elected: Messrs. Deakin and Corbet, Vice-Presidents; Mr. J. Collins, General Secretary; Mr. White, Secretary of Committee; Mr. Madison, Curator. The other officers were re-elected. The election of Committee and vote of thanks to retiring officers brought the meeting to a close.—November 11th. Mr. H. Hawkes exhibited specimens of *Osmunda regalis*, *Ophioglossum vulgatum*, and *Botrychium Lunaria*, our only native examples of exannulate ferns. Mr. P. T. Deakin then read a paper on "The Country around Christchurch, Hants." The writer described the situation of the town, and referred to its history and antiquities. It was once a seaport, but the harbour has been silted up until no large vessels can enter it. The great charm of this district to the scientist is its geology, for it gives us in the space of a few miles an almost complete section from the lower to the upper Eocene. In the Bournemouth beds we find leaf impressions and the remains of tree trunks, the latter bored through and through by a marine mollusc. Although some organic remains are to be found nearly all along the coast line, yet it is only when we come to Barton Cliff that they really abound. The writer gave lists of the fossils found commonly, and also referred to those less frequently met with, and said great interest

attached to one part where the change from marine to freshwater species was well seen. Collections of fossil and other shells were shown at the close.

OXFORD NATURAL HISTORY SOCIETY.—Tuesday, October 22nd, 1889. First meeting of the session. The President in the chair. Forty-two present. After the formal business, Professor Sydney H. Vines, D.Sc., F.R.S., gave a lecture on "The Nutrition of Plants." He spoke chiefly of green plants, and showed how the food of plants was much simpler than the food of animals. Green plants derived their food from two sources—from the soil, which furnished their mineral food, and from the air, which gave gaseous food (carbon di-oxide). Animals were solely dependent on plants for their food, either directly or indirectly. He then pointed out how important "leaf-green" or chlorophyll is. It is the sole agent for absorbing carbonic acid, the gaseous food of plants. Thus, it both feeds the plant and purifies the air. No other substance in a plant, nor anywhere else, can do it just in that way, and if there were no chlorophyll, there could be no organic life. And the lecturer rather seemed to think that the whole world might be said to depend upon chlorophyll for existence.—Tuesday, November 5th. Rev. J. W. B. Bell in the chair. The treasurer produced the statement of accounts with regard to the recent annual meeting of the Midland Union of Natural History Societies at Oxford, and was able to show the satisfactory result of a balance of £3 13s. 4d. remaining in his hands after the payment of all expenses. After the election of several new members and the proposal of others for election at the next meeting, Sir John Conroy gave a lecture on the "Causes of Colour." The lecturer confined his remarks to physical causes, excluding physiological, dealing only with pigment colours. Pointing out that the wave motions of what we agree to call ether produce in us the sensation of colour, the lecturer proceeded to illustrate Newton's doctrine of the composite colour of white light by throwing on a screen a beam from the oxyhydrogen lantern, and then refracting it through a carbon bisulphide prism on a white background to show the complete spectrum. Afterwards, letting the refracted ray fall upon backgrounds of red and green, he showed how certain rays only were reflected from each, and from a black ground none; finally, passing along the spectrum a stick of red sealing wax, which, at first invisible at the violet end, and only becoming slowly distinguishable in its progress, finally glowed like molten metal on reaching the red end. Then, passing sheets of coloured glass before the ray, he showed that this reflection was due to the absorption of certain rays, and the free passage of others through the variously coloured glasses, from which the conclusion resulted that the colours of natural bodies must vary with the colour of the light incident upon them. This conclusion was further illustrated by exhibiting under different coloured light, yellow, red, and green, produced by the burning of sodium, lithium, and thallium, a red disc fixed on a grey background, which, under the varied light, appeared in each instance of a widely varied colour. The lecture closed with a striking experiment whereby a piece of gaudily-coloured wall paper in blues, reds, and greens, when illuminated by sodium light, showed its pattern in sober harmonies of greys and browns, an effect traced to the reflection of the sodium rays from the white background on which the pattern was stamped through the gaudy colours of its surface. No discussion followed, but a hearty vote of thanks was accorded to the lecturer. The Rev. J. W. B. Bell

then described the results of further experiments on the accommodation of the colour of lepidopterous pupæ to their surroundings, showing how the reddish chrysalis of the large Tortoiseshell Butterfly, *V. Polychloros*, equally with the greyish chrysalis of the small Tortoiseshell *V. Urticæ*, and the usually green one of the Peacock, *V. Io*, was changed in colour harmoniously with the surroundings it was exposed to at the period of pupation, agreeing with these in sensitiveness to black, but differing from them in retaining something like uniformity when exposed to red surroundings (which are near to its own natural hue), in the presence of which the other two species are apt to vary widely between the extremes of light and dark forms. Mr. Pembrey followed in the same line, stating results chiefly from experiments with the pupæ of *V. Io*, agreeing in the main with Mr. E. B. Poulton's original experiments, but pointing to something in the direction of the influence of heredity in the preponderance of light or dark forms in individual broods under all surroundings.—Tuesday, November 19th. The President in the chair. About sixty present. Mr. Gotch gave a most interesting lecture on the "Functions of the Brain," of which the following is only a very brief summary. Limiting his subject to the localisation of the motor functions, and to the physiological point only, the lecturer sketched and illustrated by diagrams and lantern slides the main facts of the nervous system, the conduction of sensory impressions and motory impulses (the latter setting muscles in motion) through nerve fibres from nerve cells, the two sets of fibres, though distinct in function being externally indistinguishable. He then illustrated the development in the ascending scale of animal life of the mass of nerve cells (*ganglia*) connected with eyes, mouth, &c., the chief sensorial organs into the cerebral hemisphere, or brain, and noted the physiological fact of the crossing of the nerve fibres, resulting from the bilateral symmetry of vertebrates in the transmission of impulse from right or left portion of brain to the opposite side of the body. A series of representations of the brain of different animals was shown to demonstrate that convolutions with their corresponding fissures, affording more surface, in which it was afterwards shown that the nerve cells existed, gave a relative increase of possibility of muscular excitation, and in connection with this, the brain of man, as compared with that of his nearest vertebrate kin, the monkeys, showed greater convolution. A vertical section of the human brain was then shown, and the seat of the nerve cells, the originators of muscular impulse, pointed out as being in the grey surface of the convolutions or cortex, as it is termed, differing both in substance and colour from the white nerve fibres (serving as conductors) underlying them. The practical outcome of the physiological theory was then dealt with. The relation of a series of experiments on the brain of monkeys, whose brain was exposed while under the influence of anæsthetics, and subjected to the excitation of currents of electricity, showed that different areas of the cortical portion induce muscular action in different members of the body, leading up to the fact that abnormal muscular action, such as is manifested in various diseases, *e.g.*, epilepsy, is directly caused by abnormal conditions in a definite portion of brain-surface in which the impulse to this particular muscle originates. From this the main conclusion flowed naturally that by thus accurately localising the seat of mischief by experiments *in corpore* (comparatively) *vili*, the art of the surgeon, in treating cases of disease arising from brain affection in the human body, has received very great assistance from the physiologist, a fact which Dr. Collier and Dr. Sankey at the conclusion of the lecture bore testimony to, quoting instances in point.